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THE Connecticut legislature in 1907 passed an act establishing a special commission to give hearings and draw up for the consideration of the next legislature (1909) a bill for a public utilities commission to supersede the present railway commission of the state. A number of hearings followed, and after considerable friction a bill was drawn which, after a bitter and in some respects scandalous struggle in the legislature of 1909, ended in nothing except a bequest of the matter to the people as a lively political issue in the state campaign of the coming autumn. An interesting and unique phase of it, with meanings outside of Connecticut, relates to the attitude and policy of the New York, New Haven & Hartford, whose president opposed the measure. But he opposed it primarily because its publicity features would cramp freedom of action in matters calling for a quick decision, such as extensions on the acquisition of new properties, involving sometimes added capitalization. The situation in Connecticut is peculiar. The state has to deal not with a number of steam railway companies but practically with *a* steam railway corporation. Except the New London Northern, the single-track line giving the Grand Trunk and the Central Vermont an outlet at New London, the New Haven owns or controls all the steam lines in the state. The monopoly is, moreover, an old dividend payer with its policy under the check of a body of some 17,000 stockholders sure to resent any reduction of dividends. There is thus a natural restriction—or should be if the stockholders and directors are even moderately vigilant—more potential than a public utilities commission. A question, therefore, almost certain to arise in the next legislature is how far by law such an exceptional condition should be recognized in a new commission act. Shall such an act follow the precedent of other states with many independent railways and where "permission" must be asked of a commission for almost every new plan or shall allowance be made for the natural restraints due to single ownership and the dividend requirement of an old and highly standardized railway corporation? This somewhat novel question the next legislature of Connecticut must answer as well as the scope of the proposed commission's authority over the 700 miles or more of the New Haven's street railway lines in the state. But the latter, with rival lines building or projected, with monopoly incomplete, and with closer relations of necessity and convenience to the public than the steam road, have a different status and must meet a different line of reasoning.

THE transfer last week of stocks held by the Pearson-Farquhar Syndicate disclosed a situation having several interesting possibilities, and made a new situation perhaps as interesting. The syndicate was headed by Dr. F. S. Pearson, who handled the English end, and Percival Farquhar, who managed the operations in this country. This syndicate planned a transcontinental system. They bought stock of the Rock Island, the Lehigh Valley, the Wabash, the Missouri Pacific; the last-named company controls the Western Pacific through stock ownership in the Denver & Rio Grande. Most of their purchases were made around the top of the market at the end of 1909 and the beginning of 1910. By using securities already bought as collateral for loans by which to buy more securities, they got so far extended that they could not stand against the falling market. Their holdings were taken over by a syndicate headed by Kuhn, Loeb & Co. and Sir Ernest Cassel, of England, just before they got to the danger point. A heavy liquidation would have demoralized the market and the desirability of preventing such a situation was in itself enough to explain the action of Kuhn, Loeb & Co. The undertaking was interesting in the possibilities of such a transcontinental system as was planned by the Pearson-Farquhar Syndicate. The sequel is interesting in the consideration of what Kuhn, Loeb & Co. may do with the stocks taken over. As to the first, it does not seem that these roads could have been welded into a single strong system without tremendous expense. The eastern end, the Wabash and the Lehigh Valley, need not be considered as necessary to the system, since the lines west of Chicago could operate advantageously by giving their traffic at Chicago to some other trunk line. Of the western roads, the main line of the Rock Island and the Western Pacific are in good shape and have strong po-

sitions. The weak link is the Denver & Rio Grande. The amount of money which would have to be spent to put this on the same level as the other roads would seem to make the scheme impracticable. The policy of Kuhn, Loeb & Co. has, in general, been to centralize their banking operations in roads which are parts of the same system, or are so situated that the community of interest resulting from having their financing done by the same firm that finances neighboring roads would make for greater efficiency in operation. In this respect the firm is in contrast to J. P. Morgan & Co., who tend rather to deal with roads as individual propositions. With this policy in mind, it is hard to see why Kuhn, Loeb & Co. would care to keep their holdings in Rock Island. To run this road in conjunction with the Harriman lines would be of advantage to neither. The more probable explanation of Kuhn, Loeb & Co.'s action is that they took over these holdings primarily, aside from the need of supporting the market, because of the hold that they or the Harriman lines would get on the Western Pacific. If this interest is large, and it is believed that the Pearson-Farquhar Syndicate went into Missouri Pacific heavily, it would result in all the transcontinental lines south of the Hill territory being operated in harmony.

THE RAILWAY IN PUBLIC RELATIONS.

THE following is an extract from a kind of editorial for the guidance of the electorate of the land in which *The Outlook* advises voters as to their duties in the political campaign of the coming autumn:

> The railway question is another form of the fundamental issue between oligarchy and democracy. The railway oligarchy has regarded the railways as private property to be administered for the benefit of private owners; democracy has regarded the railways as public highways to be administered for the benefit of the public.—*The Outlook*, July 30, 1910.

This reflects what may, we think, be called not unjustly the radical view of the status of the railway in its relation to the public and to public interests—and a view not the less radical because it has of late years been so often expressed in acts of positive legislation, though, as a sweeping generality, heard more often from the lips of the politician than read in the educated editorial utterance. The flaw in it is that it contains only the half truth rather than the whole truth. It is a truism only as modified by important, if not vital, amendment.

The theory, in the first place, that proclaims the present existence of an oligarchy that regards the railways as private properties, like a factory or farm, to be administered for the benefit of the owner or owners, has the flimsiest basis in existing fact. Here and there may be found, as a kind of relic of a past railway age, an officer of a railway who holds somewhat to this "private" view, but almost never unreservedly. If found, he is an antique, old-fashioned, relegated down to us from an expired period, a kind of railway Bourbon who learns nothing and forgets nothing. As a phantom, however, conjured up from nothing he has some value as an illustration to show at one extreme of the basic conception of the railway the wrong idea at the other extreme. The spectral "private" railway is in that sense an analogue of the idea of the railway as a public highway pure and simple, which *The Outlook* practically expounds, at least to the extent of a keynote in the electoral *motif*. We may come to that idea yet, when, if ever, the government takes over the railway. But not yet.

The true idea of the railway in this country, and that shared by every intelligent railway man, contemplates the railway as a kind of intermediate property with private and public elements in close fusion. It is private as financed by private funds and seeking private profits. It is public as holding chartered rights, as having power of eminent domain, and being a common carrier, as standing in a very close relation to public necessity and convenience—and, as a logical sequel, assuming also some very grave public responsibilities. The status is well expressed by the adjective quasi-public—public in some senses, private in others, the latter including a certain fundamental right of the honest railway investor to a fair return. And that right, it is to be emphasized, is not merely a personal and fiscal one, but, when unduly threatened, protected behind constitutional bulwarks. It is a right vested not only in justice but in organic law, and with the secondary intrenchment of state statute. The trouble is in drawing the equitable line and determining where the public right ends and the private right begins. On that point rests the civic railway problem in its up-to-date phase.

Ten years ago, and for a long period before that, there was danger that the line of equity between railway and public might be drawn too far from the center and too much in favor of the railway. The "private property" idea was still overmuch prevalent. So was the illegal rebate, so was "high" railway finance; and an aggressive railway policy materializing in swift consolidations was in progress and did not end until a few years later. But recent times and events have changed all that. The "private ownership" policy is, as stated, so near extinct that it may as well be called so. Railway consolidation has paused. High finance has dropped to lowest terms, as well as the illegal rebate; and "regulation" has got a firm seat in the saddle. All along the line the railways are on the defensive against multiplied foes outside and with inside obstacles also to overcome, involving grave questions of making financial ends meet. The pendulum, having swung too far toward the railway interest a decade or two ago, has now swung the other way.

It is in such an exigency, with railway questions on a national scale in transition, that the appeal lies not to the polls and the individual voter but to the trained intelligence, the formulae of science tested and confirmed by experience, the specialist who has made railway problems his study and, further on, the courts as interpreters of railway law. Even such a national issue as the tariff is now under the immediate purview of a federal commission. It is in many respects a bigger question than the railways and bears more directly on public welfare. Yet the average voter understands it none too well and still less does he grasp the complex rights and wrongs of the public relation to the railways. Under such conditions one must see with real regret any attempt of so well-meaning and able a magazine as *The Outlook* to thrust the railways into the foreground as a popular and political issue lying between two such catchwords as oligarchy and democracy. Politics and its reflex influence on official action and policy is a bad solvent of an intensive economic situation. And the appeal to the polls means new politics and a fresh overdose of a drug already administered to the railway patient too freely.

WATERPROOFING OF BRIDGE FLOORS.

THE committee on masonry, in its report at the last meeting of the American Railway Engineering and Maintenance of Way Association, concluded, from replies received to a circular sent to members, that failures of waterproofing are due to two causes: (1) Faulty details, such as flashing along webs of girders and around corners and angles of steel work; (2) The formation of cracks from any cause. The committee decided that for any system of waterproofing to be successful the concrete must be reinforced to prevent temperature and shrinkage cracks.

Ineffective waterproofing of bridge floors causes annoyance by the discoloration of columns, beams and arches as well as discomfort by dripping of fouled water on persons using the subway of which the bridge floors form the ceiling. Waterproofing of concrete bridge floors is attempted by (1) the incorporation of some compound with the concrete to make it dense, (2) the painting of the upper surface with a cement asphaltic paint, or, (3) covering the slab with a membrane composed of layers of asphalt-saturated fabric. The ineffectiveness of any one method alone has led within the past few years to a combination of the compound or paint with a

membrane covering. Joints between slabs are generally filled with a mastic, yet the worst leaks are at the joints. Steel trough floors leak more than concrete slab floors, and an attempt to make them waterproof usually consists of filling the troughs with concrete and covering with asphaltic membrane. Concrete well puddled and with a somewhat rich mixture in the upper portion is usually dense enough to be practically impervious, but as frequently deposited in bridge floors it is entirely too wet, hence the porosity and tendency to crack. Wet concrete should be pasty rather than liquid.

In the 1910 progress report of the committee refered to, much interesting and valuable experience is given from which the committee drew the conclusions above mentioned. The most valuable idea given prominence is that of workmanship. Efficient waterproofing requires careful specifications and skilled labor. In the last analysis it comes down to faithful performance; the personal equation is a prime factor. For large roof surfaces exposed to wide range of temperature, where no waterproofing is used, T. L. Condron so distributes the reinforcing that under the live and dead loads the stresses shall not exceed 19,000 lbs. per sq. in. in the steel and the comibnation of shrinkage stresses with live and dead load stresses shall not exceed 25,000 lbs.; also for cross reinforcing, where there is presumed to be nothing but shrinkage stress, he allows a stress of 50,000 lbs. per sq. in. All of these stresses are allowed only in steel having an elastic limit of not less than 50,000 lbs. per sq. in., and for bars having a mechanical bound. He determines the shrinkage stress by considering that the concrete has a tensile strength of 200 lbs. per sq. in. and balances the tensile strength of the concrete by a stress in the steel of 50,000 lbs. per sq. in. Hence, the amount of reinforcing to take care of shrinkage stress alone would be $^1/_{250}$ of the cross-section of the concrete in the direction to be reinforced against cracking.

Waterproofing washes do not give satisfaction in many cases. L. J. Hotchkiss, assistant bridge engineer, Chicago, Burlington & Quincy, reports the use of asphaltic paint, which, he says, can be easily scraped off the concrete with a knife blade; and a tar paint which penetrates the concrete to a depth of perhaps ⅛ in. and cannot be scraped off. The tar paint is composed of 1 part kerosene, 4 parts Portland cement and 16 parts refined coal tar. A membrane is used on many roads, in some cases consisting of layers of felt with asphalt between and in other cases burlap is used instead of felt. Mr. Hotchkiss found the tarred felt somewhat stiff and lacking in tensile strength. It was found so difficult to fit into angles or over the various corners or inequalities of the surface on which it had to be laid that it was abandoned. Mastic composed of 1 part asphalt and 4 parts sand was tried, but this quickly cracked and was abandoned. A burlap saturated with asphalt was tried and gave good results. It was, however, expensive and hard to handle on account of its stiffness. A plain 8 oz. burlap was later used and found to be very strong, extremely pliable and easily put in place. It has been used in all subsequent work. For the first two seasons it was laid 3-ply and covered with 1 in.. of asphaltic mastic. Mr. Hotchkiss said:

"A few leaks developed at each subway, and in one place the mat of burlap and its mastic covering was found to be torn apart over the columns of the curb line. At this point the concrete slopes steeply down from the main girder over the street to the thinner girder over the sidewalk. It is thought the tendency of the ballast to slide down this incline developed a force sufficient to rupture the waterproofing. The slide from the street girder to the sidewalk is being made much flatter. Before the burlap mat is laid on, a piece of gas pipe is placed at the end of the street girder and the mat laid over it. As the mat is completed the pipe is withdrawn, leaving a projection or fold in the mat. This is pressed down as smoothly as possible and the mastic carried over it. By this means we hope to provide an expansion joint which will take care of any movement which may occur and at the same time secure a continuous layer of waterproofing material. We are also making the mat five-ply instead of three.

"The three-ply protection has now been in service about two years and has given fair satisfaction. As previously mentioned, a few small leaks have developed, but none of them is serious. With the use of a five-ply mat, and the change in method over the curb line columns, we expect to get entirely waterproof subways which will remain in that condition indefinitely.

"In this construction but little reliance is placed on the mastic as a waterproofing medium. It is intended to protect the mat of burlap and asphalt from damage by track tools. It is used intead of concrete because it can be made much thinner, as the head room is limited.

"No effort has been made to have the mat adhere to the concrete. The mat is carried well down over the abutments and an efficient system of drainage provided. At the right-of-way lines the mat is flashed up onto the parapet and into a groove in this parapet, the whole being protected by a layer of concrete. It is sometimes claimed that the waterproofing must adhere to the concrete. This result can only be accomplished when the concrete is dry. As a result it is often necessary to keep important tracks out of service for several days. With our method the waterproofing can be placed on damp concrete, if necessary, and the results so far attained have convinced us adhesion between the mat and the concrete is not necessary.

"The decision as to what is the best kind of asphalt for this work is very hard to make. We have used both Gilsonite and oil asphalts, and are not yet prepared to say which is the best. We have made various laboratory tests. These include the determination of the specific gravity, the percentage of bitumen, of parafine and inorganic matter, the percentage of volatilization at various temperatures, the condition of the material at 0° F., the difference in penetration of a weighted needle before and after the material had been heated to 400° F. These tests are not considered conclusive. There is, however, a wide variation in the behavior of different asphalts under the tests, and they furnish the best guides to making a selection which we have found so far.

"We expect to try a partially distilled coat of tar pitch instead of asphalt, placed in the manner outlined above, and believe that with either material, placed carefully under efficient supervision, a durable and waterproof coating may be secured."

To apply a membrane covering, the practice is to heat the asphalt to a temperature specified by the company supplying it and then swab it over the concrete, which has been previously cleaned, with mops. Over the hot asphalt is placed a layer of burlap in 40-in. strips, this layer being then coated, after which a second layer, or ply, is laid, the process being continued until 3, 4 or 5-ply work is done, as required by the specifications. The asphalt mastic is composed of 1 part of asphalt heated to about 400° F. and 4 parts of clean torpedo sand heated in pans to drive off all moisture. The sand and asphalt are then mixed and heated together in open kettles to a temperature of nearly 450° F., being constantly stirred during the operation to prevent sticking and burning. The mastic is laid in two layers and lightly tamped or rolled.

The appearance of many subway bridges of handsome design shows them to be marred by leaking, even where considerable expense has been incurred for waterproofing. It apparently shows that proper drainage has been neglected. A ballasted floor should therefore be so formed on top that water may readily flow away. A series of depressions should be made with a 2 per cent fall toward the ends of the bridge. These depressions should be about 4 ft. wide on top with a straight slope each way to the bottom. When the floor is made of a number of slabs the joints should have a key recess to be swabbed with hot asphalt and then tamped full of asphalt mastic. Water that may get through the membrane will be able to run off on the surface of the slab to the ends of the bridge. On top of the waterproofing membrane title drains should be laid in the bottom of each depression and end in a cross tile back of each abutment It is evident that with ample provision made for water to flow off, the waterproofing will guide this water to the drains and will not, as is now too frequently the case, have to act as a reservoir. Waterproofing and drainage should go hand in hand.

Letters to the Editor.

UNENTERPRISING SUPERINTENDENTS.

Craig Mountain Railway, Winchester, Idaho, July 11, 1910.

TO THE EDITOR OF THE RAILWAY AGE GAZETTE:

The article in your issue of July 1 in regard to politeness on the part of employees toward the public has interested me very much, because the writer assumes that the superintendents of most railways are making constant effort to secure and keep

polite-spoken men in the service. As a matter of fact, I do not believe there is one superintendent in ten who ever gives the matter a thought. Why should they? Their superior has never insisted that politeness toward the public was absolutely necessary. The matter of being polite is left entirely with the individual, to do as he pleases, from the superintendent down.

If it is an agent who is at fault the passenger or shipper who is wrathy will address a letter to the superintendent or perhaps the general manager. In the latter case it is probably referred to the superintendent without comment, unless it should happen that the complainant is personally known to the management. In either case some little correspondence results and the agent is cautioned by a curt and unfeeling letter from the superintendent not to quarrel with the public. This ends it; the file is closed. This agent will be careful for a time, perhaps—it will depend on how well he likes his job—but a great many do not. Or, he may be an old offender and know by experience that he will not be discharged. I have known cases where men of this disposition have been retained for years.

What should be done, if possible, is to bring the operating branch of the management to understand the importance of politeness toward the public, and let superintendents be selected who are capable of understanding what is wanted. They will then have little difficulty in selecting agents and conductors who are naturally polite and willing to see that their clerks and brakemen are courteous. There is an opportunity for many roads to become popular with the public by taking action along this line. Let it be known that the traffic department of the road is not entirely dominated by the operating department, so that a complaint may be handled on its merits with a view to correction, and the atmosphere will begin to clear of complaints at once. The management of a road that is willing to do this will make a record.

I wonder how many superintendents have ever asked an agent, conductor, brakeman or telegraph operator, in hiring him, if he expected to deal kindly and fairly with the public, telling him that if he did and made friends for the company (and himself as well) among his customers, his service in this respect would be regarded with great favor? There are not many in the West, judging from my own experience. I am sure I was never asked such a question. Let politeness become a condition in the hiring and retaining men in the service, and let the head of each department know that this is essential, and they or their lieutenants will find time to become acquainted with and watch the men under them with some measure of care. As it now stands very few roads are well acquainted with the men they have meeting the public, and the officers pay but little attention to complaints unless some influential shipper makes one and makes it strong enough to warrant a change. I am not anxious to have this article printed, but am writing it for the benefit of the editor who wrote the article referred to, as it seems to me he blames our employees of to-day, when I know that as a class they are to-day better in every way than they were fifteen years ago. They are better educated, and consequently more ambitious.

Almost anything can be done with a young man starting in the service who is ambitious; and just as soon as the management of any road sees fit to take advantage of such a man's temperament, good results are sure to follow.

Large complaints come to the traffic department of a road, and the traffic department should be given more authority, at least sufficient to warrant a careful investigation on their part without fear of insulting the operating department. This, with a reform in hiring superintendents and men who will make friends for the company, will go a long way toward solving the problem.

This is a large subject and the railways need friends among the people. Some more articles in your paper touching on the facts in the matter will go a long way toward fixing the attention of prominent railway officers on the needs of the situation.

W. J. BOHON.

TRANSPORTATION AND TRAFFIC IN RUSSIA.*

BY LOGAN M'PHERSON.

The area of European Russia is 2,166,829 sq. miles. In the interior, as well as vast tracts of forest, are fertile lands on which are raised rye, maize, wheat and other grains; cattle, sheep and horses are grown in great numbers; extensive coal-beds underlie different regions; there are veins of gold, silver, platinum, copper, iron, lead, zinc and tin.

The backward development of the means of transportation is exemplified by the fact that the miring of Napoleon's army in the swamps was a prime reason for the lack of success attending the march on Moscow. The first governmental highway was completed between St. Petersburg and Moscow in 1834. The national highways were gradually extended until at present they cover about 10,000 miles. Although the national government bears the entire expense of maintenance, amounting to $3,650,000 annually, two-thirds of these roads are under the direction of district officers, and the other third under the direction of local communities.

The rivers of Russia are among the largest in the world, the Volga flowing through 2,220, the Ural 1,500 and the Dnieper 1,340 miles. The first attempt at canal construction was at the instance of Peter the Great, who wanted to establish connection between the Don and the Volga, but work was brought to a sudden stop in 1701 by the war with Sweden and never resumed. An attempt at connecting the Don and the Oka was also brought to an end by the war with Turkey. The first completed canal connected the Volga with Ladoga Lake, and was under construction from 1704 to 1706. This was the first step in that network of waterways providing communication between the Caspian and the Baltic seas, which were built at various times during the next hundred years. Before their construction vessels were dragged overland from one river to another. During the first half of the nineteenth century a half dozen small canals were built to connect the Dnieper and the Moscow with the Volga. Many of these were enlarged during the last quarter of the century and many have fallent into disuse. The Moscow is the only river on the improvement of which considerable expenditure has been made. For the last fifty years have been discussed projects for connecting the Black and the Baltic seas; the Baltic sea with the Arctic ocean; the Caspian, the Azov and the Black seas. They are still being discussed without practical result, the railways having developed channels of traffic that cause these projects to be of less importance.

The total extent of natural and artificial waterways in European Russia is 37,000 miles, of which about 22,000 miles are navigable, the remaining 15,000 miles being available for rafting. Of the navigable reaches steamboats traverse a little over 13,000 miles. The work of the government has been principally devoted to connecting the rivers that flow into the various seas. Of the rivers and their tributaries thus connected a length of only about 2 per cent. is of canals. Before the days of steamboats the hauling was largely by hand, as many as 600,000 men engaging in this labor in the intervals of agricultural employment. The loading and unloading of all traffic is even now done exclusively by workmen in a most primitive manner without any mechanical appliances except the so-called windlass.

Of the craft now used on these waterways 3,295 are steamboats and 23,175 barges. A half dozen companies own from 10 to 55 steamers each, and 626 merchant vessels are owned and operated by local communities. Barges, as a rule, are still owned by small proprietors, who generally possess one or two, rarely as many as five.

All of the canals have been built by the government, with one or two inconsiderable exceptions, which were subsequently purchased by it. During the last hundred years the capital expenditure on the interior waterways has approximated $500,000,000. The average annual appropriation for improvements

*A preliminary report to the United Waterways Commission.

during the past ten years has been $850,000. The annual expenditure for maintenance and operation is about $6,000,000. No tools are charged except on the Ladoga canal, the Dniester and Tess rivers and the Moscow improved waterway. The total return to the government from these tolls is $90,000 a year, of which $75,000 is passed to the general state revenue.

In 1907 these waterways carried 39,663,000 tons of freight. The traffic is very largely of rafts of logs and lumber, these forming from 90 to 100 per cent. of the traffic on many of the rivers.

All of the inland waterways are under the supervision of the Ministry of Ways of Communication through the Section Waterways under which are inspectors of navigation. For such craft as carry mail and run on a regular schedule, the government fixes maximum rates of freights, below which these crafts can charge as they please. Rates on other watercraft are made at the will of their owners and are subject to wide fluctuation. There are, however, regular classifications of freights.

Russia for many centuries has been an agricultural country, the traditions of the vast majority of its population being that of tillers of the soil. This has been a large factor in preventing the momentum given manufacturing by Peter the Great continuing with anything like a corresponding pace. This condition contributed to the delay in the extension of railways. The first was a short line built in 1836 to connect the Czar's palace at Tzarskoe Selo with St. Petersburg. The next line was that between St. Petersburg and Moscow, celebrated as having been built under the Czar's dictum that it pursue an absolutely straight line, the dispute between contentious engineers, each of whom favored a different route, thereby being settled. This line was completed in 1846.

There was not a great deal of railway building during the next 20 years, the principal construction being directly by the government to serve military and strategical purposes. About 1860 it became evident that the great natural resources of the empire were susceptible of tremendous development, and both Russian and foreign capital was enlisted in the construction of railways to serve commercial needs. The government in nearly all cases issued bonds to the proprietors, guaranteeing the interest and in some cases dividends on shares.

From the first the government prescribed maximum rates for passengers, for live stock, and freight in general. From the first were tariffs for fast freight and slow freight. The latter was of three classes, the first including metal wares, cotton and woolen goods, wine, tea, coffee, sugar and other high class merchandise; the second principally the raw materials of manufacture; the third, foodstuffs, wood, stone, coal and so forth.

The railways soon carried freights at less than the maximum rates, adjusting their tariffs to their own profit, and bringing about through competition the same kinds of discriminations between shippers and between localities, that arose out of similar conditions in the United States. There was bitter complaint on the part of shippers and the government suffered because the loss of revenue to the fighting companies compelled it to furnish large amounts to make up its guarantees of interest. Various laws passed between 1880 and 1886 endeavored without success to bring about an equitable and orderly status. In 1889 a new law was passed establishing special departments in the Ministry of Finance for the reform and subsequent direction of all matters pertaining to the tariffs. This law is still in effect.

The control of the tariffs is under a Tariff Council, presided over by the Minister of Finance and composed of Directors of the Ministry of Ways of Communication, representatives of agriculture, trade and manufactures, and of the private railways; a tariff committee composed of members of different ministries, which decides less important questions; and the Department of Railway Affairs, which works out the adjustment of railway tariffs. The decisions of each body are subject to appeal to the next higher body, those of the Minister and Tariff Council to the Senate. Under this law was undertaken the compilation of statistics of traffic and the bi-weekly publication of the *Magazine of Russian Railway Traffic*.

To do away with unrestrained competition between rival lines, the government made regulations distributing the traffic between such lines, and adjusting the division of through rates. New tariffs were finally established for the different railways that provide fixed terminal charges for the diffierent classes and progressively lowering, that is, tapering charges for transportation. The practice of the railroads, which tended to nullify the effect of the protective tariff by making lower charges on import freight was abolished.

It was soon found that exceptional rates would have to be made for the great staple products if they were to find any extended markets. Special rates were therefore made upon grain, salt, coal, lumber, kerosene and naphtha, flax and hemp, sugar, live stock. In the succeeding years the number of exceptional rates has been vastly extended to meet the needs of particular commodities in finding a market. Very low rates have been made on long distance traffic, especially that destined to Siberia, which as a market for manufactures of Russia is analogous to the region west of the Missouri river, which is a market for the manufactures of the eastern and middle districts of the United States. Especially low rates have been made on products of export and that the products of one region may compete with those of another in common markets.

It will be seen that the modification of the tariffs of Russia has been similar to that in the tariffs of Germany. In both countries following discontent with the rates made by the railways under the regime of free competition, the government endeavored to bring the tariffs under a mathematical formula, to which, however, it was soon found that numerous exceptions would have to be made in the interest of industry and commerce. These exceptions in Russia, as in Germany, have become very numerous and very important. While their main purpose has been to build up traffic to and from the port of St. Petersburg and to develop traffic with Siberia, they have also in large measure tended to foster traffic between one place and another within the empire.

In an important respect the Russian government not only permits but promotes that competition of the railways with the interior waterways which has been a natural development in the United States, but has been forbidden in both Germany and France. During the season of navigation the railways make "navigation tariffs," which are lower than their regular tariffs, in order to compete with the rivers and canals.

The Russian government in the adjustment of railway rates finds itself between the horns of a dilemma. Inasmuch as the revenue of the state railways and the taxation of the private railways is the source of a considerable revenue which is much needed, there is little or no making of experimental rates for the purpose of developing traffic. Reductions in rates are only made when it is absolutely certain that an increased traffic will bring a greater net revenue.

The length of railways in European Russia on December 1, 1909, was 31,345 miles of standard gage, which is five feet. In addition there were 1,355 miles of lines of narrow gage and secondary importance. These figures are exclusive of 1,976 miles in the Grand Duchy of Finland. Of the standard gage lines in European Russia the government owns and operates about 20,000 miles; private companies about 11,000 miles. The cost of these lines has averaged about $40,000 per mile. In 1908 the railways of the empire, including the 9,000 miles in Asiatic Russia, carried 145,000,000 passengers and 180,619,596 tons of freight, the revenue per mile averaging over $10,500. The government is still obliged to make contributions to the private lines under its guarantee of interest, but the amount decreases almost steadily year by year. It points to this and to the fact that some of the commercial lines are beginning to pay dividends as justification for the assertion that there is great opportunity for the profitable investment in Russia of capital in additional rail-

ways that are much needed in the development of the great natural resources of the empire.

The freight cars used on the Russian railways at first had a capacity of but four tons. Later nine tons became the standard, but in recent years many cars with a capacity of twenty tons have been placed in service. Here, as in other countries of Europe, it has been difficult for the railways, even with the offer of especial inducements, to persuade shippers to provide loading in the large quantities necessary to make the use of large cars profitable, but the situation has improved in recent years.

The facts and statistics embodied in this report were obtained either directly from officials of the Russian ministry or from publications authorized by the Russian government.

RAIL FASTENINGS AND THE LIFE OF TIES.

We are indebted to Hermann von Schrenk, supervisor of timber preservation of the Chicago, Rock Island & Pacific, for the following abstract of, and comment on, a paper on the effect of rail fastenings on the life of ties, presented by Herr Oberingenieur Zwingauer, of Berlin, at a recent meeting held in that city.

Attention is called in his address to the decreasing quantity of hardwoods and the consequent necessity for using more and more pine for tie purposes. It is generally recognized that the length of life of all kinds of ties depends upon two factors: protection against decay and protection against mechanical wear. The lecturer says that the protection of ties against decay, as now practiced in Germany, fully serves its purpose; that is, one can efficiently treat ties chemically so as to obtain a long length of life. The protection against mechanical wear, however, is not as efficient as it might be. He finds that maintaining a solid track by screw spikes and tie plates adds very materially to the mechanical life of ties. One of the most important points in the application of screw spikes has been more or less overlooked, viz., the maintenance of a correct relation between the diameter of the hole bored for the screw spike and the diameter of the core of the screw spike. In an interesting table he shows that there is a variation in the diameter of the core of screw spikes, used on the various railways in Germany, France, Austria and Switzerland, of from 0.59 to 0.65 in., and in the whole screw of from 0.79 to 0.90 in. This table is as follows:

	Spike.		Hole, diameter. in.	Difference between core and hole (bored) diameter. in.
	Core diameter. in.	Outside diameter, including thread. in.		
Imperial Rys. of Alsace Lorraine	0.65	0.85	0.35	0.29
Oldenburg Government Rys....	0.59	0.85	0.51	0.08
Würtemberg State Railways ..	0.59	0.81	0.51	0.08
French Eastern Railway.....	0.65	0.90	0.59	0.06
Prussian State Railways	0.65	0.85	0.61	0.04
Saxon State Railways	0.59	0.79	0.55	0.04
Bavarian State Railways	0.59	0.79	0.55	0.04
Mecklenburg State Railways ..	0.59	0.79	0.55	0.04
Austrian State Railways	0.59	0.79	0.59	..
Swiss State Railways	0.59	0.83	0.59	..

It will be noted that the size of the holes bored for the screws varies from 0.35 to 0.61 in. In other words, there is as large a difference as 0.29 in. between the size of the core of the screw and the hole bored in the tie. So, for instance, the Imperial Alsace Lorraine Railways, for a screw spike having a core diameter of 0.65 in., bore a hole 0.35 in. in diameter, the Prussian State Railways, for a screw having a core diameter of 0.65 in., bore a hole 0.61 in. in diameter, while the Austrian and Swiss Railways, using a screw with a core diameter of 0.59 in., bore a hole 0.59 in. in diameter. The finding of this variation led Herr Zwingauer to make a series of tests to determine the influence of the size of the hole bored for the reception of the screw spike on the holding power of the screw. The results are shown in the table.

The conclusion from this table is that "the figures show with sharp dividing line for the greatest holding power, which in the case of pine is 0.51 in., and for oak and beech, 0.59 in.," using a screw having 0.65 in. core diameter.

In view of the fact that many roads in this country are laying experimental sections of track with screw spikes, it would seem from the above results that it will be very essential to make a critical study as to the influence of the diameter of the hole on the holding power of the screw for our various American tie woods. It is, of course, all important that the maximum holding power of the screw be obtained.

Average Holding Power (in pounds) in Wooden Ties of Screw Spikes and Other Spikes with Various Size Holes.
(*Average of five tests.*)

Size of hole—	*Screwspikes* (Diameter, 0.65 in.).					*Ordinary spike.*	
	0.43 in.	0.47 in.	0.51 in.	0.55 in.	0.59 in.	0.63 in.	Without hole	Hole 0.20 in.
Pine ...	4,280	4,930	5,200	4,680	4,470	....	2,920	3,560
Oak....	....	9,430	9,110	9,830	10,100	9,390	.....	.....
Beech...	....	11,350	11,660	11,880	12,580	12,260	....	....

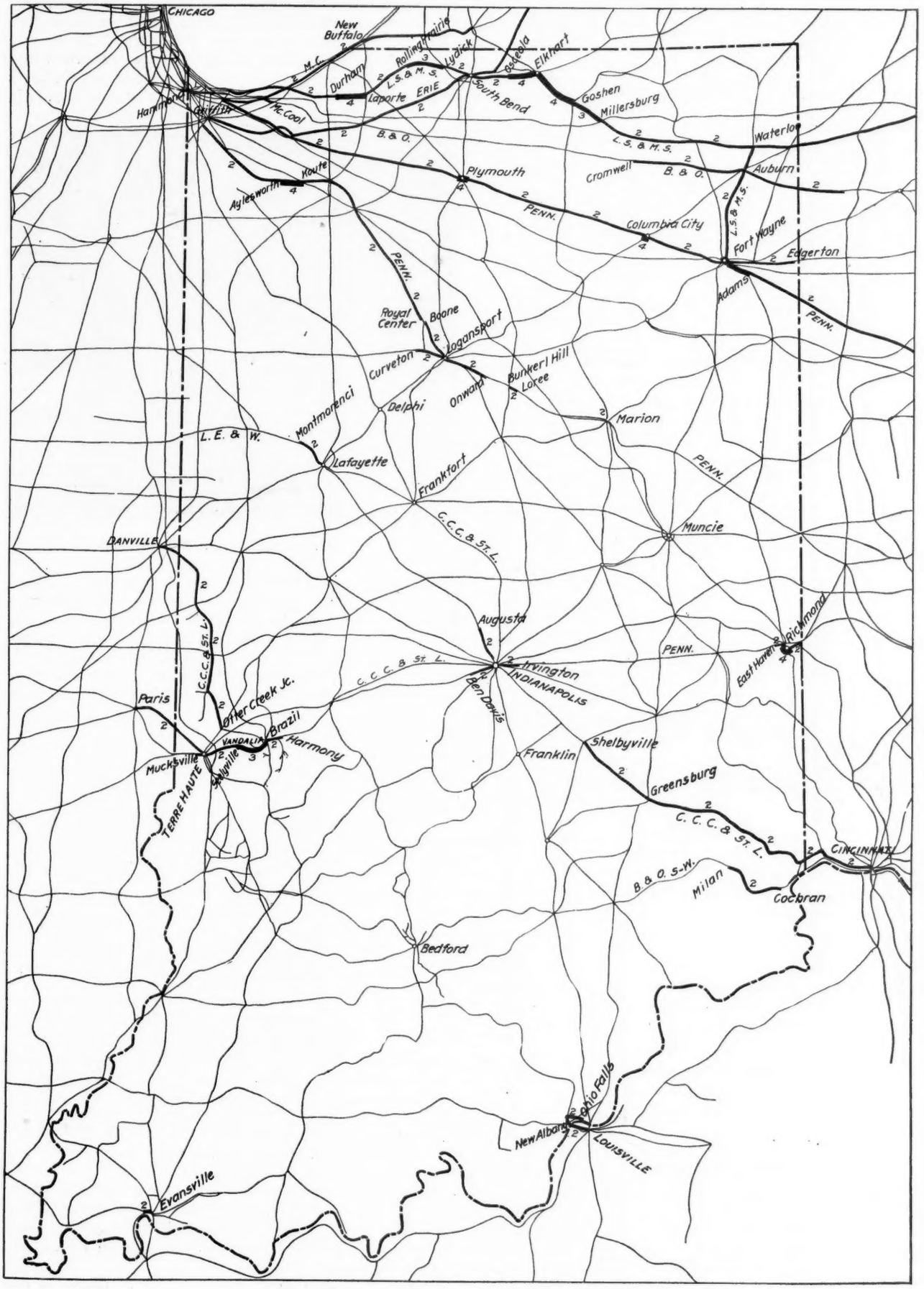
From a recent examination of sections of an experimental track, provided with screw spikes, I received the impression that too little attention has been given to the matter of boring holes, and I believe that the results obtained by Herr Zwingauer are of particular interest to American roads at this time.

TWO, THREE AND FOUR-TRACK RAILWAYS IN INDIANA

Those sections of railways in the State of Indiana on which there are two or more main tracks are shown in the accompanying map. On the White Water Division of the Cleveland, Cincinnati, Chicago & St. Louis there is some double track which does not appear on the map, as exact information of its location is wanting. In the region of Chicago, where the ground is literally covered with tracks and where almost every line is at least double, we have not attempted to show the situation on this small scale map. The limits of this Chicago territory are indicated by the line drawn across the northwest corner of Indiana.

Railways of two tracks, three tracks and four tracks are distinguished from each other in the map by the thickness of the lines in the drawing. The termini of the sections having more than one track are as follows:

INDIANA.	No. tracks.	Approx. miles.
Baltimore & Ohio.		
Mark Centre, Ohio, to Cromwell	2	52
McCool to Chicago, Ill	2	43
Baltimore & Ohio Southwestern.		
Cochran to Milan	2	16
Louisville, Ky., to New Albany	2	4
Chicago & Eastern Illinois.		
Danville, Ill., to Otter Creek Junction	2	49
Cleveland, Cincinnati, Chicago & St. Louis.		
Cincinnati, Ohio, to Greensburg	2	63
Greensburg to Shelbyville.	2	20
Crosby to Augusta	2	14
Erie.		
Griffith to Hammond (joint with C., C. & L.)	2	9
Hammond to Chicago, Ill. (C. & W. I.)	2	20
Grand Trunk.		
Port Huron, Mich., to Chicago, Ill.	2	330
Lake Erie & Western.		
Lafayette to Montmorenci	2	9
Lake Shore & Michigan Southern.		
Edgerton to Millersburg	2	51
Millersburg to Goshen	3	8
Goshen to Osceola	4	25
Osceola to Lydick	2	17
Lydick to Rolling Prairie	3	13
Rolling Prairie to Laporte	2	7
Laporte to Durham	4	6
Durham to Pine	2	32
Pine to South Chicago	4	9
Indiana Harbor to East Side, Ill.	4	6
Louisville & Nashville.		
Howell to Evansville.	2	2
Michigan Central.		
New Buffalo, Mich., to Grand Crossing, Ill.	2	58
New York, Chicago & St. Louis.		
At Fort Wayne	2	3
Hessville to Grand Crossing, Ill.	2	17

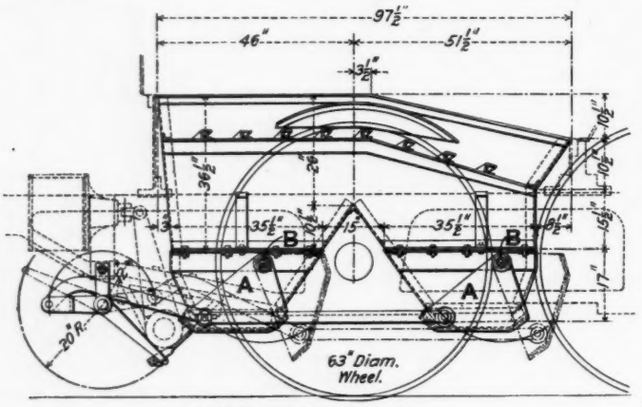


Two, Three and Four-Track Railways in Indiana.

	No. tracks.	Approx. miles.
Pennsylvania Lines.		
Van Wert, Ohio, to Adams.	2	28
Adams to Fort Wayne	3	5
Fort Wayne to Columbia City	2	19
At Columbia City	4	..
Columbia City to Plymouth	2	45
At Plymouth	4	..
Plymouth to Whiting	2	67
Whiting to Colehour, Ill.	3	3
Ohio State line to Richmond	2	4
At Richmond.	4	..
Richmond to East Haven	2	3
Irvington to Indianapolis	2	5
At Marion	2	3
Loree to Bunker Hill	2	2
Onward to Curveton	2	17
Logansport to Boone	2	9
Royal Centre to Kouts	2	45
Kouts to Aylesworth	4	4
Aylesworth to Illinois State line	2	28
Ohio Falls to New Albany	2	6
Vandalia		
Indianapolis to Ben Davis	2	6
Harmony to Brazil	2	3
Brazil to Seelyville	3	8
Seelyville to Macksville	2	9

WINE SELF-DUMPING ASHPAN.

The Atlantic Coast Line has adopted the Wine self-dumping ashpan as the standard on all of its locomotives, the changes to be made as rapidly as possible. The general feature of the design is shown in the accompanying drawing. The bottom of the hopper is closed by the slide A, which is pivoted or hung from the stud B. The mechanism by which it is moved to and fro consists of an ordinary arrangement of levers and connections which are operated from the side of the locomotive. It



Self-Dumping Ash Pan.

will be seen that the bottom is in the form of a pan that rises on all sides around the bottom of the hopper and thus seals it against leakage. When opened, it swings clear of the bottom so that there is a free opening for the flow of the ashes.

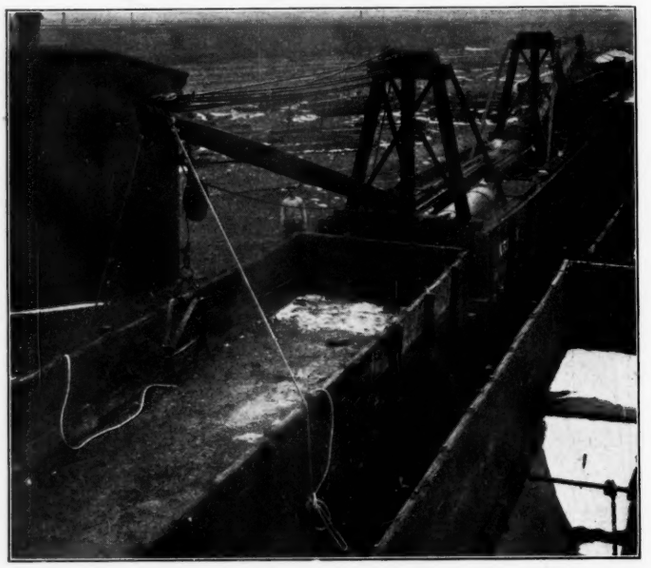
The hoppers are separated from the main body of the pan and are held to it by key bolts, so that when it is necessary for a workman to go into the pan the keys can be easily knocked out and the hoppers dropped down.

AIR RAIL LOADER.

The equipment here illustrated for handling rails has been developed on the Baltimore & Ohio, and has given excellent service in handling rails up to the heaviest in general use.

It consists of two stiff-leg derricks set up in the ends of a wooden gondola and equipped with the necessary appliances for operating the lifts by air. The drawing shows the details of the derricks, the timber frame on which they are carried, and the cylinders, air tanks, pipes and four-way cock.

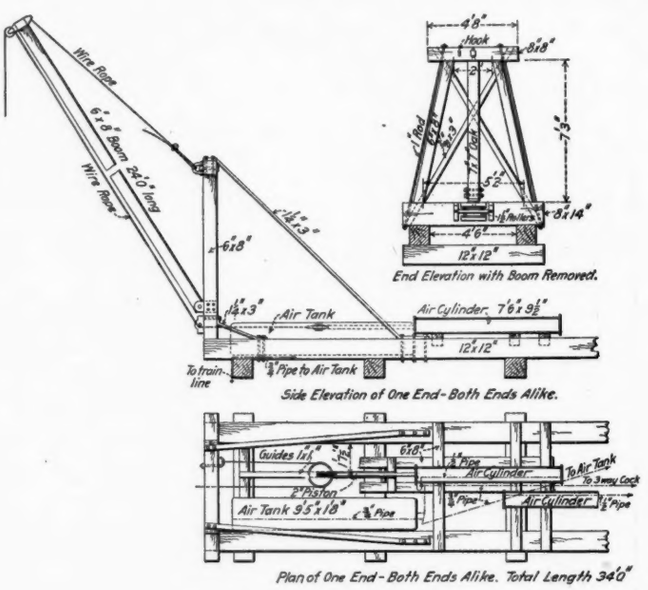
The transverse 12-in. x 12-in. timbers of the frame rest on the floor of the car, and are securely bolted to it with ¾-in. bolts. The photograph shows the general arrangement of cylinders, air tanks and feed pipes, and also the tongs for lifting the rail, with the lines and pulleys for lifting the boom. The boom is furnished with two rings for attaching the sheave; these, with the links on the end of the ¾-in. cable which supports the boom, enable the position of the sheave to be adapted to the length of the car placed for loading or unloading. Air



Air Operated Rail Loader.

is supplied through a ¾-in. pipe tapping the train line 2½ ft. back of one of the angle cocks and leading to the two storage tanks. The rail loader is operated at 70 lbs. pressure, and it is necessary to equip the work train locomotive with an extra air pump in order to maintain this pressure for rapid work.

Seven men to a boom are required to work the loader to its capacity. One such gang will load or unload as much rail in



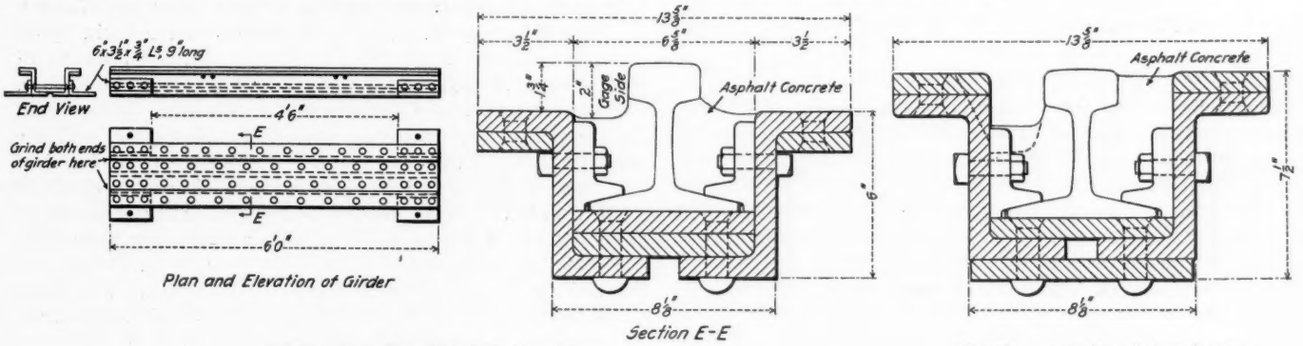
Details of Rail Loader.

a day as a gang of 20 men throwing it on or off the cars. With gangs operating both ends of the loader simultaneously, the work will proceed somewhat less than twice as fast—on account of having to switch the cars more frequently—but the cost of handling per ton will be less.

We are indebted to G. D. Brooke, division engineer of the Baltimore & Ohio, for the above description.

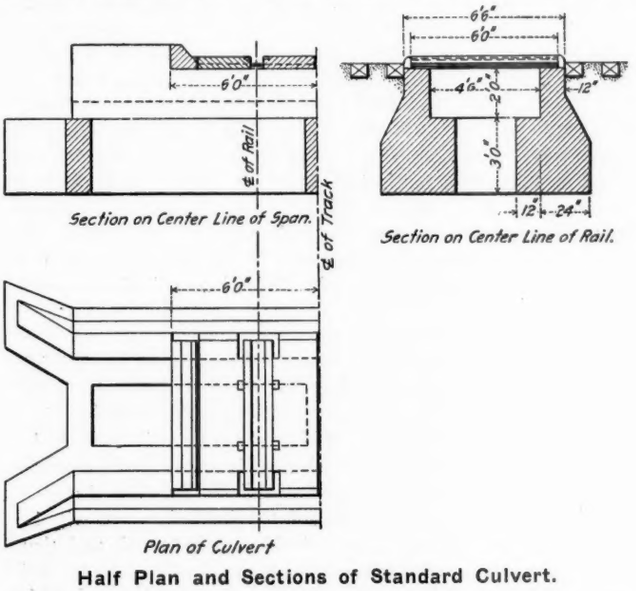
STANDARD CULVERT TOPS; CHICAGO & NORTH WESTERN.

For narrow culverts, such as those under roads and streets, the Chicago & North Western has lately adopted reinforced concrete slabs with the rails carried in a trough girder built up of Z-bars and narrow plates, the details being shown in the accompanying cuts. These show the standard used on culverts



Girder for Standard Culvert. Section of Special Girder.

with 4 ft. 6 in. openings, and a modified design for culvert or gutter crossings on paved streets. The trough girders for carrying the rails rest at the ends on the culvert walls and for the whole length on the edges of the slabs. The slabs are 6 ft. long and 6 in. thick, reinforced top and bottom with electrically welded wire cloth having a 2 in. x 3 in. mesh of Nos. 0 and 5 wire. Between the rails the slabs are 2 ft. 1⅜ in. wide and the same width of slab is placed against the outside on each side of the track. In the standard design a curb is placed on the outside of the outer rail and a slab 3 ft. 1½ in. wide is used on the inside when the line is double tracked. On paved streets the curb is omitted and the rail is dropped in an ingenious manner to bring the head flush with the top of the slab, which is even with the surface of the pavement. The



Half Plan and Sections of Standard Culvert.

space on each side of the rail in the trough girder is filled with an asphaltic concrete. This may be readily removed if required and at the same time is preserved from rust, while there is no space for dirt to collect. The construction seems well calculated to secure a good piece of work at reasonable cost as it is standardized and simple.

The bills of material, for one track, are as follows:

STANDARD CULVERT.

Concrete deck for one track:
10 wire sheets.
1¼ cu. yds. 1:1:2 concrete.
1 piece cedar 4 in. x 12 in. x 6 ft. for blocks.

Add to above material for each additional track:
10 wire sheets.
1⅓ cu. yds. 1:1:2 concrete
1 piece cedar, 4 in. x 12 in. x 6 ft.
2 girders.
8 cast-iron rail clips.
18 connection bolts for rail clips.
8 anchor bolts, 1-in. diameter, split end with wedge, hexagonal nut, 3-in. thread

Material for one girder:
2 6 in. x 3½ in. x ¾-in. Z-bars, 6 ft. long.
2 2¼ in. x ¾-in. plates, 6 ft. long.
2 6¾ in. x ⅜-in. plates, 6 ft. long
4 6 in. x 3½ in. x ¾-in. angles, 9 in. long.

SPECIAL CULVERT.

16 ft. 1½ in. wide concrete deck for one track:
10 wire sheets.
2 cu. yds. 1:1:2 concrete.
1 piece cedar, 4 in. x 12 in. x 6 ft. for blocks.

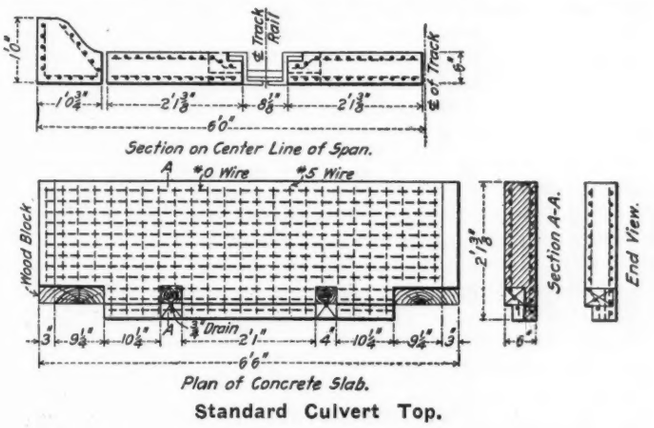
Add to above material for each additional track:
10 wire sheets
1⅓ cu. yds. 1:1:2 concrete
1 piece cedar, 4 in. x 12 in. x 6 ft. long.
2 girders.
8 cast-iron rail clips.
18 connection bolts for rail clips.
8 anchor bolts, 1 in. diameter, split end with wedge, hexagonal nut, 3-in. thread.
8 ¾-in. x ¾-in bars, 2 in. long.

Material for one girder:
2 6 in. x 3½ in. x ¾-in. Z-bars, 6 ft. long.
2 3½ in. x ¾-in. plates, 6 ft. long.
1 6¾ in. x ¾-in. plates, 6 ft. long.
1 8 in. x ¾-in. plate, 6 ft. long
4 6 in. x 4 in. x ¾-in. angles, 9 in. long.

GENERAL NOTES.

Plates and shapes: Open-hearth structural steel.
Rivets: Rivet steel, ¾-in. diameter.
Composition of concrete in deck to be 1 part of cement to 1 part of sand to 2 parts of torpedo gravel.
Rail joint to be off girder in every case.

The drawings were given to us by W. H. Finley, assistant chief engineer of the Chicago & North Western, who writes:



Standard Culvert Top.

"The special culvert is designed to span the gutters where we cross public streets. The conditions specified were that we should give a 4-ft. clear span and that the rail should not project above the level of the street. Our standard plan was designed to meet conditions where we require track drainage that cannot be taken care of by ordinary track box. This frequently occurs in cuts and other places. In fact, it is intended for any low, shallow opening where height does not permit a regular construction. Various schemes have been developed for crossings of this sort, such as three rails with the running rail between

the two reinforcing rails, etc. In other designs, by putting in reinforced concrete slabs, we avoid the open pit and can carry derailed cars without danger of a mix up. It will be noted that the rail does not require any special work, and that the fastenings are so arranged that the section men can readily take out and replace a rail." The plans were made in the office of J F. Stern, bridge engineer of the road.

INTERNATIONAL RAILWAY CONGRESS.

TOWN TUNNEL CONSTRUCTION.

Several interesting reports were brought up on tunnel construction. The subject of great town tunnels in Great Britain had been entrusted to Francis Fox, who gave an historical survey of tunnel construction which has mainly been within the London area. He pointed out that it was the existence of the great bed of London clay which had enabled the construction of the deep tube electrical railways to be carried out without injury or disturbance to any great extent of the property on the surface. By the system which was adopted for the tube railways the tunnels had been placed at such a depth that not only was interference with the innumerable sewers, water and gas pipes, telegraph and telephone cables avoided, but the water in the gravel beds was not encountered except at the stations. Mr. Fox's historical survey extended back to the Thames Tunnel of Brunel, from which he noted that engineers had learned many lessons, the troubles which arose in connection with its construction having been largely due to the fact that it was placed at too high a level. Mr. Fox proceeded to describe in chronological order the construction of the Metropolitan & District Railway tunnels and the first tube railway, the City & South London. He reminded the congress that the Tower Subway was the forerunner of all tunnels driven by circular shields, one of the assistant engineers having been James G. Greathead, whose name will ever be identified with tubes and tube tunneling. It was usual, he pointed out, in tube tunneling to construct two separate tunnels, a practice which presented many advantages, chief among which was the fact that such a method was cheaper, owing to the smaller amount of excavation. The other tube railways, the Waterloo & City, the Central London, the Great Northern & City, the last named distinguished by the fact that the tunnels were constructed of sufficient size to accommodate the rolling stock of the Great Northern Railway, and the later tube railways constructed by the Underground Electric Company of London were also described. Mr. Fox pointed out that the Charing Cross, Euston & Hampstead, with a length of 8 miles, was constructed in something over two years by Price & Reeves. Mr. Price introduced his electrical digger for the purpose of accelerating that work with great success, and a distinct improvement in the air of the tunnel was perceptible whenever the electrical excavator was at work. Other tunnels described were the Mersey Railway, the Glasgow District Subway and that of the Glasgow Central Railway.

Mr. Fox expressed the opinion that the construction in congested districts in London of shallow railways such as had been proposed would involve such enormous cost as to be prohibitive, although outside congested districts, or under new streets, there was little doubt that shallow subways would be generally adopted. An important reform suggested by Mr. Fox with which those who have experience of the long underground walks imposed on those who use the tube railways in London will be in sympathy is that the lifts should deliver passengers at platform level immediately between the up and down rails. On the subject of the ventilation of tube railways, while admitting that on some of the existing lines there were deficiencies in this respect, he expressed the belief that if laid out on a scientific basis a satisfactory ventilation system could be introduced. From purely engineering matter Mr. Fox passed on to deal with more controversial points, suggesting that in consideration of the enormous boon they had proved to the public, and the low fares charged, the tube and other suburban railways should be exempted from local rates and passenger duty. He believed that any such relief would contribute to the public welfare by encouraging further construction, and suggested that municipal assistance for raising capital should be authorized. The opinion was also expressed by this reporter that omnibus and motor traffic should be called on to contribute towards the construction and upkeep of roads in order that the competition between them and tube railways should be placed on a fair basis.

The subject of tunnels under large cities other than London was reported on by M. Canat, chief engineer of the Paris, Lyons & Mediterranean. There were, he pointed out, few instances of such tunnels in the case of main lines of railway in Europe, although in America they were more common. When such tunnels were constructed they were of two types, the ordinary tunnel with metal roof, examples of which were to be found at Budapest, at Berlin, at Boston, at Philadelphia and in the New York subway; and the arched tunnel, the latter the method adopted on important main lines, such as the New York Central and the Pennsylvania Railroad at New York, the Sceaux line and the Austerlitz line at Paris, and elsewhere. The shield method had been tried for such tunnels, but the difficulties were so great that that method of construction had to be given up. In the construction of the Paris tunnels innumerable obstacles were met with, quicksand being encountered, while another difficulty peculiar to the Paris subsoil was the frequent occurrence of old quarries. A remarkable feature about the building of arched stations, as in the case of the Paris Metropolitain line, was that even where the tunnel was at a great depth below the surface of the ground there was no hesitation to have a very flat arch, even with a span of 46 ft., and the Orleans Railway had even constructed such a flat arch, having a span of 66 ft. 3 in., at the entrance to the Quai D'Orsay station. Special works were found in the tunnel of the Pennsylvania Railroad which formed the approach to the central Manhattan station. With regard to crossings, the most remarkable work of the kind that had been carried out was that under the Place de l'Opera of the Paris Metropolitain, where there were three tunnels, one over the other. M. Canat said it had been difficult to obtain information as to the net cost of town tunnels, but at Budapest the cost, including superstructure and electric installation, had been $265 a yard, while at Berlin the average cost of the tunnel alone had been $495 a yard, and the Vincennes—Porte-Maillot had cost $400 a yard. The ventilation of town tunnels was a very complex problem. A commission appointed by the Municipal Council of Paris has the subject under investigation at the present time. The solution at present adopted in Paris consisted in providing large ventilated openings up to 500 square ft. wherever possible, only using fans if the openings were too small or too far apart. That mixed solution had given appreciable, if incomplete, results.

ALPINE TUNNELS.

This subject was reported on by F. Hennings, of the Zürich Polytechnic School, who described the Jungfrau line tunnel, the Ricken tunnel, the Loetschberg, the Karawanken and the Simplon tunnel. Opportunities for visiting the works of the Loetschberg tunnel, giving direct communication between Berne and the Simplon, had been afforded delegates while in Berne, and a considerable number took advantage of the invitation. It will be remembered that the tunnel is a double track tunnel, and that trouble has been experienced with water bearing sands and gravels, with the result that the tunnel had to be diverted, adding 805 yards to the length of tunnel to be driven. In the case of the Jungfrau line tunnel, which was also visited by delegates, this has been opened for traffic for some time past to Eismeer, which is 10,368 ft. above sea level, and the continuation of the tunnel from Eismeer station to the Jungfraujoch, 11,330 ft. above sea level, is now in progress. The tunnel will be finally continued from the Jungfraujoch to the Jungfrau station, which will be the terminus of the line. That station will be 13,432 ft. above sea level. From thence a lift 240 ft. in height will convey passengers to the summit of the mountain. It was pointed out that the tunnel was remarkable, not only

on account of its great elevation, but for the steep grade over two miles of tunnel, ending at the present terminal station, Eismeer, being on a gradient of 25 per cent. The section of tunnel now being driven, 2⅛ miles in length, will have a gradient of 6.6 per cent., and the final section to the Jungfrau station will be 25 per cent. The difficulties in connection with the deficiency of water and the gradient prevented the Brandt hydraulic drills from being used. Up to Eismeer station electric percussion drills of the Siemens-Schuckert type had been employed, but in the section above Eismeer station the work was being carried out with Ingersoll compressed air drills, with which the monthly advance was 115 yards, compared with 85 yards on the Eigerwand-Eismeer section with the electric drills. The Jungfrau is a narrow-gage tunnel, 11 ft. 9¾ in. wide and 13 ft. 11⅝ in. high. The total length to the Jungfraujoch will be four and a half miles, and there will be the further section thence to the summit station. Tunnel ventilation during operation was also discussed by this reporter. Mr. Hennings, in an interesting résumé, stated that the system which had been found to give the best results was that of Saccardo. The reporter recommended the double-track system of construction in the case of long Alpine tunnels, the use of a top cut instead of a separate top heading, and where high rock temperatures, or great pressures, or much water were expected, he advised the construction of an underheading as a satisfactory system. It was also desirable, he thought, that experiments should be made with armored concrete blocks to determine their suitability for tunnel lining. The cost of Alpine tunnels was difficult to determine, but the contract price of the double-track Loetschberg was to be $640 a yard. The mean cost of the south side of the Karawanken tunnel was $1,010 a yard, while the cost of the difficult pressure sections of the St. Gothard and the Simplon tunnels was estimated at over $4,500 a yard. The cost of operation was a most important point in connection with Alpine tunnels, and another important detail was the upkeep of the track. The quick wear of the rails and plates in the Simplon tunnel was a quite unexpected phenomenon and had not yet been explained. In the St. Gothard tunnel during the years 1900-1907 the upkeep of the track cost $395 a mile per year, or twice as much as in the open country.

M. Canat reported on tunnels in mountainous countries outside the Alps. Many tunnels were described in this report. As a general rule, it was stated, most of these long tunnels were straight in plan, and a typical cross section had a width of between 26 and 27 ft., with a height of about 19 ft. 8 in. above rail in the case of double-track tunnels and a width of 16 ft. 5 in. for single-track tunnels. In the case of tunnels of medium length the top heading system was frequently employed, but in other parts of Europe there were few instances of such construction. At the same time, top heading working had economy in its favor. For very long tunnels, however, bottom heading working was to be recommended. With regard to machine drilling, the Brandt drill was unique of its kind, but had not yet succeeded in establishing its superiority. Compressed air drills were of many types, and they all worked well and gave good results. Electric drills had now passed beyond the experimental stage. Many statistics were also submitted as to the ventilation of tunnels in operation, and this reporter confirmed the statement made elsewhere that the Saccardo system had proved satisfactory, but had the disadvantage of being comparatively high in cost of operation.

IMPROVEMENTS IN LOCOMOTIVE BOILERS.

Nine reports were presented on this important subject. Practically the whole interest of the discussion turned on the economies which have followed the adoption of superheating in locomotive work. It was shown, in the course of the debate which followed the reading of the paper by George Hughes before the Institution of Mechanical Engineers recently, that, in addition to the Lancashire & Yorkshire and the Great Western Company, other British companies were now carrying out tests of the economy of superheaters, notably the London, Brighton & South Coast Railway. It is common knowledge that on the Continent the majority of railway administrations have been or are trying superheated steam on locomotives.

M. Dassesse brought before the Congress some interesting figures on his report for France, Belgium, Italy, Spain and Portugal. He pointed out that the economies of fuel and of water were in direct ratio with the amount of superheat, being greatest when the locomotive did considerable, and above all, continuous work. In trials carried out on the Belgian lines the realized economies had reached 29.64 per cent. of coal and 28.67 per cent. of water, but attention was directed to the fact, now generally recognized, that the saving only began to be appreciable with from 80 to 108 deg. Fahr. of superheat. In service as well as in test runs the economy of superheating has been clearly demonstrated. Single-expansion superheated steam locomotives could, it was claimed, show an economy of coal of up to 18.20 and even 22 per cent, as compared with similar saturated steam locomotives which had done the same work. It was shown that a temperature of 608 deg. Fahr. was, in the case of single-expansion locomotives, the best from the point of view of efficiency and the proper preservation of the different parts. By equipping a compound locomotive with a superheater, its efficiency was increased, the four-cylinder express compounds of the former French Western Railway being from 13 to 14 per cent. more economical than similar compounds using saturated steam. Moreover, superheating made it possible, in the case of compounds, to effect economies of coal which were found on the Belgian State Railway, and 7.3 to 10 per cent. in the trials made on the Italian State Railway, also with express locomotives—both figures being per indicated horsepower. As superheating was more economical the lower the initial pressure of the steam, it was not, as a rule, advisable to have a high pressure in the boiler. The great cost of upkeep of boilers working at high pressures was thus avoided.

G. Noltein, the reporter for Russia, produced more confirmatory evidence as to the gain following superheating. He said that, when properly managed, the superheated steam locomotives consumed, as a rule, 15 to 30 per cent. less water and 8 to 20 per cent. less coal than saturated steam locomotives for an equal amount of power. The small additional cost of lubrication was held to be comparatively unimportant. He pointed out that the improvement of the parts in contact with the superheated steam was continually progressing. The Stumpf valve gear would probably make superheated steam working still more economical, and it was consequently advisable to try and adapt it as perfectly as possible to the conditions obtaining in locomotive service. Moderate superheating had proved unsatisfactory, even in the case of compounds. It was desirable to attain high temperatures—up to 662 Fahr.—in the valve chest. Loss through superheated exhaust steam was hardly to be feared. The best steam pressure for superheated steam working appeared to be about 170 lbs. per square inch. With proper treatment, the cost of maintenance of the superheated steam locomotive was not higher than that of the saturated steam locomotive. In Germany, Holland, Switzerland and northern Europe superheatd steam is now being used on a larger scale. The reporter stated that the W. Schmidt smoke-tube superheater, which was generally preferred, seemed at present the most suitable system for producing superheated steam. The superheaters of the Pielock and Clench-Golsdorf designs had at present only received limited applications, but as they were cheap and easy to build and look after, they seemed useful in cases in which one was content with steam having a temperature of 518 to 554 deg. Fahr. Superheated steam compound locomotives with four cylinders are now frequently used, and progress in this direction seems to promise good results.

In America, with one exception, those roads which have equipped engines with superheating appliances have done so as an experiment only. The Canadian Pacific has adopted superheating extensively and has at the present time about 475 such engines in service. The engines with the Schmidt smoke-tube superheaters are entirely successful, and during their first six months' service showed a saving of 18 per cent. in fuel com-

pared to compound consolidation engines of a similar, though slightly smaller, type which had been constructed two years previously. The results obtained have been, on the whole, exceedingly satisfactory. Figures derived from extensive service on all sections of the road, and based on the total quantity of fuel delivered to the engines, have shown an economy in fuel of from 10 to 15 per cent. in passenger service. A noticeable difference between simple engines using superheated steam and two-cylinder compound engines using saturated steam is in the greater flexibility of the simple engine. The general experience in Canada and the United States, therefore, with regard to the use of superheated steam may be summarized by the statement that a substantial economy in coal has been effected; that on account of conditions this economy is not as great in freight service as in passenger service, and that in the latter a considerable benefit is obtained from the increase in the capacity of the engine.

PERISHABLE FREIGHT.

The reports under this title elicited a long discussion. J. M. Culp, Southern Railway, who reported for English-speaking countries, dealt with the matter from both aspects. His main argument was that as the commodities forming the list of perishables are disinguished by the fact that practically the entire list contributes to the support, or amelioration, of human life, it was of the very highest importance that this particular form of traffic should be delivered to consumer with the least possible deterioration. A disposition to full co-operation on the part of the producer must, however, be assumed and relied on. Mr. Culp said experience had proved the adequacy and success of the American car. He pointed out that the present types of cars had been evolved from experiments, beginning with the refrigerator car patented by William Davis, of Detroit, Mich., in 1868. That car was built primarily for the transportation of fish. No improvement effected by carriers—not excluding quicker schedules—had produced such economic results as the refrigerator car. The present fresh meat, fruit and vegetable industries, represented in America by millions of dollars of investment and affecting thousands of square miles of territory, were almost entirely the product of this. The production and distribution of fresh meats had evolved during the past 30 years from strictly local distribution to a national wealth reaching into the millions; the traffic from fruit and vegetable-growing districts had brought wealth to wide areas and thousands of individuals.

In England conditions greatly modified the necessity for specializing the handling of perishable freight. Although each management reported that perishables originated to some extent on their lines, the need for special facilities appeared mainly in connection with imports. English railway managements relied mainly on rapid transit for the successful handling of perishable traffic.

The management of Indian railways unquestionably felt that with the present demands their traffic in perishables did not require the use of other than ventilated vans or wagons handled in passenger train schedules—a conclusion which Mr. Culp assumed to be sound. From demonstrated results in other sections of the civilized world there might be found by the management of the Indian railways in the fruit and vegetable traffic a fertile opportunity not only for increasing their own revenues but for stimulating the production of a variety of food products, lessening the disastrous effects resulting from the occasional failure of any one of the crops now grown.

The Australian situation was unique by reason of the encouragement being given by the government through the provision of cold storage depots, which, together with the provisions already made by the carrier, presaged a large growth of traffic in that territory.

Richard Bloch, of the Orleans Railway, who reported for all countries except those using the English language, treated his subject with great thoroughness. Mr. Bloch found that, as a general rule, these traffics were growing rapidly in consequence of more general prosperity, in crease in wealth and in population and greater and greater facilities given by the administrations. This progress was especially striking in the case of produce, such as fruit and vegetables, where the different countries in a way supplement each other.

Mr. Bloch dealt with the work of the International Clearing House established at Brussels, which liquidates all the accounts concerning the joint through traffic of England, France, Holland, Belgium, Germany, Switzerland, Austria-Hungary and Italy. The continuity of the growth of this traffic showed clearly that the saturation point of the international market was far from being reached, and that there was still room, and ample room, for all the efforts on the part of exporting countries. Under these conditions, it was thus not a question of a fight of ejection between these different countries; far from opposing each other, the progress of the one would contribute toward helping the progress of the other. This was shown by the instance of the German market, where the new and growing intervention of French trade did not hinder the continuous increase of imports from Italy. Rather must it be a strife of emulation, in which, besides the qualities peculiar to the producers, success would depend less on the rate charged for the carriage than on the care devoted to it.

SEMAPHORE BLADE PAINT.*

BY ROBERT JOB.†

In painting semaphore blades the common practice some years ago was to use the so-called English or Chinese vermilion, the red sulphide of mercury. This pigment was mixed or ground with linseed oil, and, while the paint was fresh, the coating gave a brilliant and striking signal. It was found, however, that on exposure to light and sulphur fumes a gradual darkening took place, due to the chemical reduction of the pigment or the formation of the black sulphide.

Under favorable conditions a fair life was obtained, but in unfavorable surroundings, darkening or blackening took place rapidly, and repainting became necessary after relatively short exposure. Unfortunately, too, the price of the material was extremely high and out of all proportion to the durability obtained. Owing to these reasons, strenuous efforts were made to secure a substitute equally brilliant at the outset, but having the advantages of greater serviceability, with lower initial cost. Experiment was made with various inorganic pigments, such as American vermilion (basic lead chromate), mineral orange, and other substances, but they were found to be unsatisfactory in one characteristic or another, and did not have the requisite brightness of color or else did not retain the color satisfactorily on exposure.

The field of organic reds had been largely developed and thorough trials were made of a number which appeared promising. It was found, as a result of these service tests, that many of these reds, such as eosine, were extremely fugitive and faded very rapidly on exposure; others gave fairly satisfactory results. The para diazo reds were the most permanent and generally satisfactory and retained their brightness for considerable periods of time, even under unfavorable surroundings. The shade of this red was not as bright and striking as desired, though it was improved by the addition of mineral orange (Pb_3O_4). The latter material, when present in any considerable proportion, caused blackening, due to formation of lead sulphide, but good results were obtained when the proportion of mineral orange did not exceed 10 per cent. Other diazatized and developed aniline reds have recently been brought out, and exposure tests of these are now under way. The para diazo red was precipitated upon various bases, but in service tests barium sulphate was found the most satisfactory. Paints prepared with varying proportions of para diazo red precipitated upon barium sulphate were tested carefully by exposure and it was found desirable to have present not less than 20 per cent. of the red in order to ensure a good degree of permanency with little evidence of fading after a year's service.

*From a paper presented before the American Society for Testing Materials, June 30.

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Shop Section.

THE first prize of $50 in the shop kink competition, which closed June 15, has been awarded to C. J. Crowley, piecework inspector at the West Burlington (Iowa) shops of the Chicago, Burlington & Quincy. The winner of the second prize of $25 is E. G. Gross, master mechanic of the Central of Georgia, at Columbus, Ga. Eight other collections of kinks were entered in the competition, all of them good, and some of which follow the prize winners closely, so closely, in fact, that the awarding of the prizes proved a most difficult task. Of the ten collections, one was made up entirely of engine house kinks and another of car repair kinks. All of the kinks will be published in the September Shop Number. The names of the competitors, other than the prize winners, with no attempt to arrange in the order of merit of the collections are: William G. Reyer, general foreman of the Nashville, Chattanooga & St. Louis, Nashville, Tenn.; John V. Le Compte, assistant foreman, Baltimore & Ohio, Mt. Clare shops, Baltimore, Md.; K. J. Lamcool, special apprentice, Chicago, Indianapolis & Louisville, La Fayette, Ind.; A. S. Willard, foreman, Norfolk & Western, Crewe, Va.; C. J. Drury, general roundhouse foreman, Atchison, Topeka & Santa Fe, Albuquerque, New Mex.; Guy A. Adams, foreman freight car shops, Boston & Maine, Concord, N. H.; James Stevenson, foreman, Pennsylvania Railroad, Olean, N. Y.; and S. S. Lightfoot, bonus demonstrator, Atchison, Topeka & Santa Fe, San Bernandino, Cal.

WE announce an engine house kink competition to close September 15, 1910. A first prize of $35 will be given for the best collection of two kinks,, and a second prize of $20 for the next best collection. More than two kinks may be submitted, but the judges will base their decision on what they consider to be the best two in each collection. Contributions that are used for publication, but are not awarded prizes, will be paid for at our regular space rates. Nowhere are time and labor saving devices of greater value than in an engine house, and this is especially true during times of heavy traffic, when every minute saved in getting an engine ready for service means dollars in the treasury. Kinks may be found in greater or less numbers in every engine house, but their use has often become so common that their value, as compared to methods used elsewhere, is overlooked or forgotten. A master mechanic remarked some time ago that if the kinks used in all the engine houses could be collected and the more important ones placed in general use, the effect on improved engine house efficiency and output would be stupendous. Won't you help to make the results of this competition as valuable and effective as possible by contributing your mite? No great effort will be necessary on your part. Send us blueprints, sketches or photographs of the kinks and describe their construction, use and advantages in a simple way, being careful to make the descriptions as complete as possible. Possibly you have time or labor-saving methods or practices which do not require illustration. If so, don't hesitate to send them to us. If you have only one kink which you consider of value, send it in and if acceptable it will be paid for at our regular rates.

FOUR other competitions, in addition to the enginehouse kink competition announced above, will be held within the next five months. The one to close October 15 will be on "The Care and Selection of Machine Tools and Shop Equipment." The subject has purposely been made as broad as possible in order that all of our Shop Section readers may be able to participate. For instance, the above title need not be used as the subject or title of the article submitted. It may be on such subjects as the care of belting, the care of pneumatic tools, the upkeep of machine tools, the care of small tools or their abuse, the care of tools in a roundhouse or car repair yard, how a foreman should go about selecting the proper machine tools to recommend for use in his shop, or any one of a dozen or more subjects which come under the general title suggested. Prizes of $35 and $20 will be given for the two best articles; such others as are accepted for publication will be paid for at our regular rates. The articles should contain from five hundred to fifteen hundred words.

The competition to close November 15 will be on car repair kinks. The same conditions will apply as for the competition on enginehouse kinks, announced above. Any kink used in car repair shops or yards for either freight or passenger cars or at the terminals in connection with the cleaning or repair of car equipment may be included. We have a large number of readers in the car department, but comparatively few car repair kinks have been brought out by the general shop kink competitions, although several were submitted in the competition which closed June 15. The three articles on "Car Repair Shop Notes," in the May, June and August Shop Numbers, show that there are many labor and time-saving devices in use in the average car repair shop and yard. The good things in the car department, as in the engine house, do not appear to become generally recognized, even in any one locality, as may be seen by looking over the three articles above mentioned. The three plants considered are in the same part of Buffalo and within a mile or two of each other, and yet splendid devices were found in each one of the three, which could have been used to advantage in the other two shops or yards, and yet were entirely unknown to their foremen. If our car department readers all over the country, and outside of it, for that matter, will co-operate with us in bringing to general knowledge the many kinks which they have found of value, it should assist them greatly in giving a better account of the forces and equipment under their care.

The competition to close December 15 will relate to "Increasing Shop Output" and the same general conditions will govern as for the competition on "Care and Selection of Machine Tools and Shop Equipment." As in the case of the remarkably successful competition on "How a Foreman Can Promote Shop Efficiency," held last spring, the new competition is intended to cover a larger and broader field than that covered by the shop kink competitions. We want to know how you increased the output of your shop or department by improving the organization, rearranging the equipment or handling it to better advantage. The competition should, for instance, bring out articles on a good shop schedule and the result of its installation, a successful shop dispatching system, the arrangement and operation of a first-class bolt manufacturing plant, the best flue handling plant, how a car repair yard increased its output by better methods, how a better system of organization and operation was instrumental in improving the conditions at an engine house, or how the same results were secured with the same equipment, but smaller labor costs. These few subjects are presented merely as suggestions. There are at least a hundred more equally as good.

The fifth competition, to close January 15, will be on shop kinks and will include any kink used in connection with the repair and maintenance of locomotives or cars of all kinds. It will be governed by the same conditions as the shop kink competitions which have been held recently. The prizes will be $50 and $25 for the best two collections of three kinks. More may be submitted, but the award will be based on what the judges consider to be the best three kinks in each collection. In this, as in all the above announced competitions, kinks or articles which

do not win a prize, but are accepted for publication, will be paid for at our regular rates. Contributions may be entered in any of these competitions at any time between this and the closing date.

ALTHOUGH the Shop Number of the *Railway Age Gazette* has been in existence less than a year, it has been so cordially and enthusiastically received as to leave no doubt of the great need of the foremen for assistance in improving the efficiency of their departments and shops. It was with their needs in mind that the competitions outlined above were drawn up. Two of them, the engine house and the car repair kinks competitions appeal to special interests in the mechanical department to which the value of greater efficiency and improved economy is of prime importance, but about which little has been published which appeals to or has proven to be of much interest to the foremen in these departments. The other three competitions should appeal to our Shop Number readers generally. The subjects are carefully worded to cover a broad field and the conditions are such that the foreman of any department, or specializing in any class of work, will be enabled to participate in any one or all three of them.

THE experimental Mallet articulated compound locomotive that was placed in service on the Canadian Pacific some time ago, and which is described in another part of this issue, has proven so successful that five more of the same type are being built at the Angus shops of that company. The locomotive was designed under the direction of H. H. Vaughan, assistant to the vice-president, and differs radically from other locomotives of this type on American roads. The most important changes are in the design of the boiler and the arrangement of the cylinders. It is doubtful if a boiler of ordinary design would have the capacity of the one on the experimental locomotive, but it is, of course, not wise to adopt the new type of boiler generally until it can be proved superior to the ordinary type. To do this the five new engines will be equipped with the ordinary type of boiler and a smoke box superheater, and their performance will be compared carefully with that of the first locomotive. Mr. Evans' paper was written several months ago, and since that time the experimental locomotive has handled its tonnage satisfactorily and the arrangement of its cylinders has proved entirely successful. Extensive tests of the locomotive are being made, the results of which, it is expected, will shortly be available for publication.

A GENERAL superintendent who has been studying the problem of locomotive fuel economy suggests that improvement can best be made by securing some means of accurately weighing and charging up the fuel delivered to each locomotive. Methods of doing this, which are fairly accurate, have been used on a number of roads with splendid results. The more or less general adoption of the practice of pooling locomotives has, however, complicated the problem considerably, as was shown by H. H. Vaughan, assistant to the vice-president of the Canadian Pacific, in a paper which he recently presented at the joint meeting of the American Society of Mechanical Engineers and the Institution of Mechanical Engineers. He said: "It is almost impossible to determine the fuel consumed by an engine on an individual trip, and consequently difficult when pooling to keep any record of the amount of coal used by different men. A record may be kept by engines, but it is then impossible to locate the responsibility for any excessive consumption. The practical result is that on pooled engines, individual fuel records are of comparatively little use. With assigned engines, while trip records may not be individually accurate, the average of several consecutive trips soon becomes so, as the variation of the amount of coal left on the tender, while important on one, is of comparatively small importance on a number of trips. There is no doubt in the writer's mind that individual coal records, whether by trip or by period, are an important factor in obtaining economical results in fuel consumption, both from men and from engines, and he ascribes the good results that have been obtained on the Canadian Pacific largely to the careful way in which the records have been watched."

IN speaking on the tool room check system at the Railway Tool Foremen's convention, O. T. Harroun, tool room foreman of the Chicago & Alton at Bloomington, Ill., emphasized the importance of getting the higher officials to view the tool room in the light of a shop barometer, rather than as a non-producer. H. W. Jacobs, assistant superintendent of motive power of the Santa Fe, expressed the same thought in a little different way a few years ago, when he likened it to the ammunition for an army. No matter how well the army may be drilled or otherwise equipped, it is not of much account in time of battle if without ammunition. Progressive shop superintendents and general foremen have come to this same conclusion, and the tool room and its equipment has gradually been improved until it is regarded by many as the strategic point in planning a campaign for improved shop efficiency. With this development the tool room foreman has been forced to a higher plane and has become a more important factor in shop efficiency and economy. This was quite noticeable in connection with the work of the Railway Tool Foremen's convention, which met in Chicago last month. Although this association was only formed last December and the number of members in attendance was not very large, yet the papers were enthusiastically and carefully discussed, the matter of higher efficiency and greater economy being kept always in the foreground. With such a start this association promises to give a good account of itself within the next few years.

MECHANICAL ARTICLES DURING JULY.

For the benefit of Shop Number readers who may wish to look up mechanical articles which appeared in the *Railway Age Gazette* since the Shop Number of July 1, the following outline of such articles is presented:

Steel in Freight Car Construction. By C. A. Seley, mechanical engineer, Chicago, Rock Island & Pacific. A four-page abstract of a paper presented before the Franklin Institute, tracing the development of the use of the steel frame in gondola and box car construction, thus utilizing the side framing in carrying a considerable proportion of the load. Illustrated. *Railway Age Gazette*, July 8, page 84.

New Tank Car. Illustrated description of a new type of tank car, designed by the Chicago Steel Car Co. *Railway Age Gazette*, July 15, page 116.

Co-operative Engineering Education. By Prof. Herman Schneider. A paper read before the annual meeting of the Society for the Promotion of Engineering Education, and dealing with the progress made in the co-operative engineering courses at the University of Cincinnati. The students spend alternate weeks in the schoolroom and the workshops of Cincinnati, principally the shops of the machine tool builders. *Railway Age Gazette*, July 15, page 122.

Tests of Self-Cleaning Front Ends. A two-page summary, illustrated, of several series of tests made on the testing plant of the Pennsylvania Railroad at Altoona, to determine the best front-end arrangement for its Atlantic type passenger locomotives. *Railway Age Gazette*, July 15, page 124.

Steam Turbine Electric Locomotive. Illustrated description of the Reid-Ramsey turbine electric locomotive built by the North British Locomotive Co., Ltd., Glasgow. *Railway Age Gazette*, July 22, page 152.

Locomotive and Car Shops of the National Trans-Continental, Winnipeg, Can. A general description of this new shop plant, with data as to the various shops and their arrangement. Illustrated. *Railway Age Gazette*, July 22, page 154.

Chair Car. Illustrated description of new chair car for the Chicago, Burlington & Quincy. *Railway Age Gazette*, July 22, page 157.

Pooling Locomotives. Abstracts of papers on this subject, presented before the joint meeting of the American Society of Mechanical Engineers and the Institution of Mechanical Engineers. *Railway Age Gazette*, July 29, page 183.

Fifty-Ton Gondola Car. Illustrated description of a car with a steel underframe built by the Chicago, Milwaukee & St. Paul at its West Milwaukee shops. *Railway Age Gazette*, July 29, page 184.

IMPROVED FIREBOX WITH HOLLOW ARCH AND COMBUSTION CHAMBER.

BY F. F. GAINES,
Superintendent of Motive Power, Central of Georgia.

Several years' experience in the anthracite district of Pennsylvania caused me to become quite familiar with the combustion chamber—both the original, as applied to the Wootten type firebox, and the modified form, as used to some extent without the brick wall. While there were mechanical objections to this device, which I will take up later, there is no question but that it improved combustion and proved economical in the burning of fuel. Further, the life of the tubes was greatly prolonged, and in no case during their life did they give as much trouble as in the ordinary type of boiler. I have also found, from two engines of exactly the same type, except that one had a combustion chamber and the other had not, that the boiler with the combustion chamber, although having less total heating surface, due to the flue heating surface cut out by the combustion chamber, was in every respect the better steamer of the two. While the combustion chamber boiler has less total feet of heating surface, yet the additional firebox heating surface in the combustion chamber is of so much more value as to offset the loss in tube heating surface.

The Wootten type boiler has for years been standard on the Philadelphia & Reading, and it is well justified by the results obtained. Other roads have used it somewhat in a more or less modified form, and within the last few years several roads have applied it to engines using bituminous coal. As far as I have been able to ascertain, the results have been uniformly successful. It would seem that in such types of locomotives as require extremely long tubes, a much better heating surface can be obtained by the use of a combustion chamber and shortening the tubes, at the same time reducing the mechanical troubles due to long tubes. An illustration of the application of a combustion chamber may be found in the *Railway Age Gazette* of May 27, 1910, in the boiler of the Mallet articulated compound locomotive for the Delaware & Hudson. Some of these bituminous burning engines with combustion chambers have brick arches in connection with them, while others do not use the arch. The non-use of the brick arch seems to me to defeat the principal purpose of the chamber itself, which is largely based on the theory that to properly consume the unburned gases a sufficient volume of air must be mixed with them before their temperature has been lowered by coming in contact with the comparatively cold surface of the tubes, and that the province of the combustion chamber is to allow the air and gases to mix in proper proportions and burn in the combustion chamber before entering the tubes.

The present form of firebox with combustion chamber, as generally constructed, has several mechanical defects which render it more or less objectionable. In the first place, it is almost impossible to prevent having a large number of seams on account of the junction of the different plates coming at the throat of the combustion chamber. This is even true where a single plate is used for both the firebox and the combustion chamber by welding the two sheets together, as the throat sheet seams are still located at this point. Where the brick arch is used it is necessary, about once a week, to draw the fire and allow the arch to cool and to put a man behind it to shovel out the accumulation of cinders to prevent stopping up the tubes. This, of course, requires considerable time, and withdraws the locomotive from service while the work is being done. There is also an objection on account of the trouble experienced with cracked sheets, unless the mud is kept from accumulating in the water space underneath. Where water that is high in solid matter, either mud or scale, is used, this matter must be looked after very carefully.

Knowing the desirable features of the combustion chamber as regards saving of fuel, diminution of smoke, longer life of tubes and better steaming engine, I made a careful study of the whole matter to see what could be done to get the advantages of the design in question and eliminate the objections, and finally evolved the idea of building a boiler with an abnormally long firebox and partitioning off sufficient space at the front end by a vertical brick wall to form a combustion chamber, thus allowing the use of an ordinary spark hopper in the bottom of the chamber for the withdrawal of sparks. I further believed that the admission of heated air at a point near the top of the bridge would be of advantage in approximating complete combustion. To accomplish this the brick wall in question was made hollow, with passages through it, so that air might enter from the outside, go through the wall itself, which being hot from the high temperature of the firebox would heat the air and turn it loose to mix with the gases at top of bridge, the idea being that they would mix and burn during their passage from that point to the tubes.

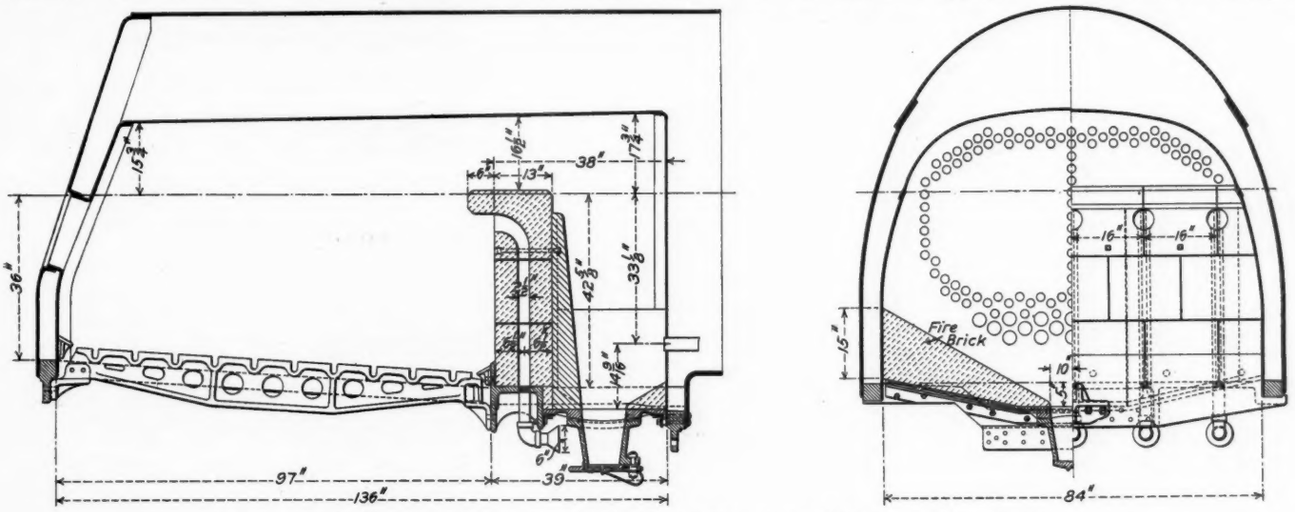


Fig. 1—Combustion Chamber and Hollow Arch as Applied to Engine 1014.

This design eliminates the trouble of removing sparks which gather in the combustion chamber and stop up the tubes. It admits highly heated air at the most desirable point for complete combustion. It also protects the flues from cold air, no matter at what point in the fire there happens to be a hole.

To carry out the idea in question, the management allowed me to apply a new back end embodying these principles (Fig. 1) to the boiler of one of our large consolidation engines, No. 1014, which had been in an accident and had a badly crippled back end. The grate area of the new firebox was made identically the same as that of our 22 x 30-in. consolidation locomotives, which are free steamers and economical as regards fuel. The combustion chamber was made shorter than would have been used if the boiler had been designed in toto for the engine. It was necessary, however, to design a back end that would go

on the old boiler and suit the running gear of the present engine, which somewhat modified the design from what would have been considered best practice. Nevertheless, the engine has now been in service some fifteen months, and so far we have yet to have the first trouble from leaking tubes, although the engine is running in a district where other engines are giving us trouble more or less all the time, and where the average life of a set of tubes is about 30,000 miles. It has been found that this engine will steam with grades of fuel that other engines cannot use; it would thus appear to be of advantage in utilizing low-grade fuels, and would probably prove satisfactory in burning lignite. The engine so far has made 37,832 miles, and the tubes are apparently in as good condition as the day they were applied. It will soon be due for general overhauling, but it is not the intention to do any work on the tubes at that time.

It has been found that the small amount of sparks that accumulate in the combustion chamber can readily be removed through the spark hopper at the bottom, but as a matter of fact the amount of sparks carried over the arch is very small. This is probably due, in the first place, to the use of a large nozzle (6½ in.), the mild exhaust not lifting anything but the smallest particles over the arch. As these small particles are lifted over, such as are combustible are probably burned before they strike the tubes, and the only sparks that are found in the combustion chamber or front end are very fine particles of slate, and there are very few of these. The amount of smoke emitted is noticeably less than on the other engines. The fuel consumption has been considerably less, and the engine in every way has proven extremely satisfactory.

Comparative Tests on Central of Georgia, Showing Advantages of Hollow Arch and Combustion Chamber.

Southwestern Division—Freight Service—Macon and Columbus.

	Engines			
	1014.	1020.	1719.*	1715.
Coal A:				
Coal consumed, per 1,000 ton-miles, lbs.	102.00	152.00	108.00	119.00
Water evaporated per lb. of coal, lbs.	8.10	5.70	8.57	7.72
Relative efficiency	100.00	67.11	94.45	85.72
Excess of coal consumed, per cent.†	.....	49.02	5.88	16.67
Coal B:				
Coal consumed per 1,000 ton-miles, lbs.	100.00	141.00	.....	114.00
Water evaporated per lb. of coal, lbs.	8.12	5.65	.....	7.44
Relative efficiency	100.00	70.93	.....	87.72
Excess coal consumed, per cent.†	.....	41.00	.....	14.00
Coal C:				
Coal consumed per 1,000 ton-miles, lbs.	96.00	139.00	.....	110.00
Water evaporated per lb. of coal, lbs.	8.25	5.93	.....	7.66
Relative efficiency	100.00	71.95	.....	90.92
Excess coal consumed, per cent.†	.....	44.79	.....	14.58
General average of all coals:				
Coal consumed per 1,000 ton-miles, lbs.	99.00	144.00	108.00	114.00
Water evaporated per lb. of coal, lbs.	8.15	5.76	8.57	7.61
Relative efficiency	100.00	68.76	91.67	86.84
Excess coal consumed, per cent.†	.....	45.46	9.09	15.15

*Engine 1719 out on test of Margaret and Petros coals, account of arch burnt out and no material on hand to repair.

†Based on engine 1014 as unit.

Engine 1014—21 x 32-in. Cooke consolidation, with new firebox and combustion chamber, with hollow brick wall and provision for mixing hot air with burning gases. Total heating surface, 2,987.33 sq. ft.

Engine 1020—Same class engine as 1014, but with original boiler unchanged and no brick arch. Total heating surface, 3,022.29 sq. ft.

Engine 1719—22 x 30-in. Baldwin consolidation, wide firebox, and Wade-Nicholson hollow arch. Total heating surface, 3,230 sq. ft.

Engine 1715—Same as engine 1719, but without brick arch. Total heating surface, 3,230 sq. ft.

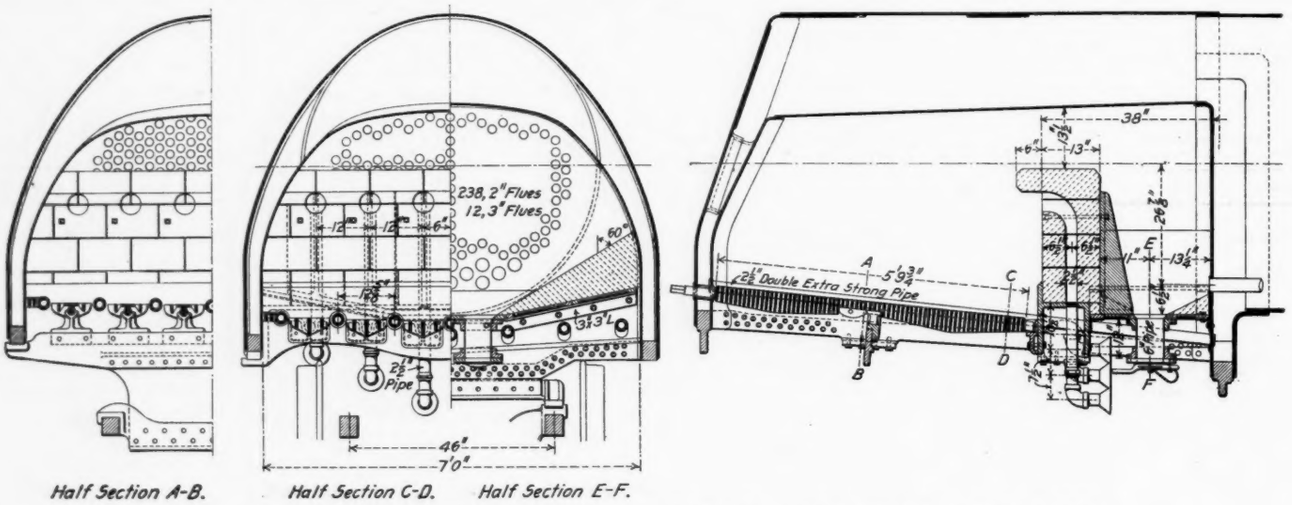


Fig. 2—Combustion Chamber, Hollow Arch and Water Bars as Applied to Engine 1065.

The management has also allowed me to apply this revised back end to the boiler of another consolidation locomotive, No. 1065, of smaller size, the firebox of which had been badly damaged by low water. On this locomotive I decided to utilize the experience I had had in regard to circulation of water in Wootten type fireboxes with longitudinal grates having a water bar between each grate. This was embodied in the second engine, in connection with the hollow brick arch and combustion chamber, as shown in Fig. 2. This engine has been in service about four months since being rebuilt, and while no official tests have been made as to fuel economy, the road foreman of engines and engineers report that it is one of the most satisfactory engines on the division, and there is every reason to believe that the fuel economy will be as good as on the first engine.

A record of a test of the first engine is given herewith. In this test the train was composed of 18 cars (100,000 lbs. capacity) of company coal, and the same train was used throughout the entire series of tests, thus eliminating any error due to the difference in class of work or weights used during the test. The same engineer and firemen were used on all the tests. Three grades of coal were used from three different mines, and they are designated as "A," "B" and "C."

On the data sheet of the comparative tests engine 1014 is the one with the combustion chamber; engine 1020 is a sister engine of the same class, but with the original boiler not equipped with a brick arch; engine 1719 is an engine of better design with a wide firebox and a Wade-Nicholson hollow brick arch; engine 1715 is the same class as the 1719, but without the arch. Engine 1719 was not used in the tests with the last two grades of coal, as the arch gave out and we did not have material on hand to make repairs. The showing made by the 1014 over the other engines was very satisfactory and substantial. In making the tests, all coal used was weighed and put in sacks. Following are the general data and dimensions of locomotives 1014 and 1065:

Engine	No. 1014.	No. 1065.
Type	2-8-0	2-8-0
Tractive effort	43,619 lbs.	34,000 lbs.
Weight in working order	197,275 "	168,575 "
" on drivers	175,875 "	148,075 "
" on truck	21,400 "	20,500 "
" of engine and tender.	310,875 "	274,575 "
Wheel base, rigid	15 ft. 5 in.	16 ft. 0 in.
" " total	23 ft. 9 in.	24 ft. 3½ in.
" " engine and tender	54 ft.	55 ft. 9¼ in.
Cylinders, diam. and stroke	21 x 32 in.	20 x 28 in.
Driving wheels, diameter	55 in.	57 in.
Boiler pressure	200 lbs.	200 lbs.
Firebox, length and width	96⅝ x 84 in.	72 x 84 in.
Heating surface, tubes	2,794.0 sq. ft.	1,971.0 sq. ft.
" " firebox	125.9 "	88.2 "
" " comb. chmbr.	67.4 "	55.0 "
" " water bar	.....	22.8 "
" " total	2,987.3 "	2,137.0 "
Grate area	56.36 "	42.0 "

Shop Kinks.

From the Silvis Shops of the Rock Island Lines.

The most important shop plant on the Rock Island lines is located at Silvis, Ill., about 175 miles west of Chicago. Four important divisions radiate from this point. The shops are comparatively new, having been placed in operation in February, 1904. G. W. Seidel is shop superintendent.

JIG FOR DRILLING CYLINDER SADDLE BOLT HOLES.

A full set of cylinder saddle bolt holes may be drilled in three hours by means of the jig shown in Fig. 1. As indicated, they are drilled from the inside, the former practice at Silvis being to do it from the outside. The frame of the jig is constructed

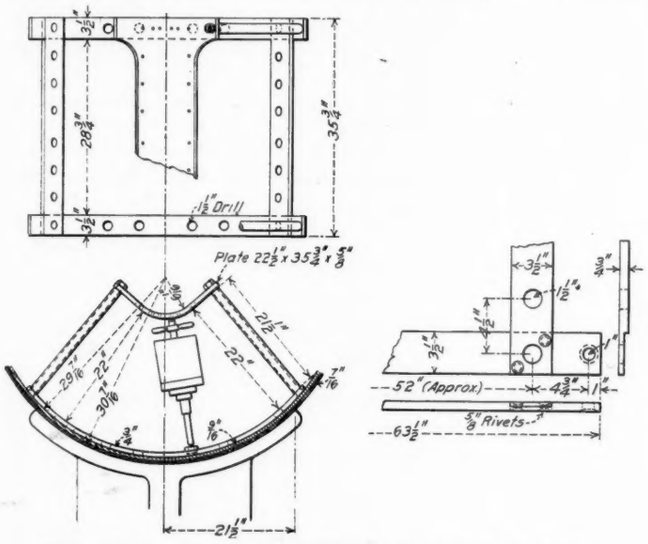


Fig. 1—Jig for Boring Cylinder Saddle Bolt Holes.

of four pieces of ¾ x 3½-in. common iron and a 22½ x 35¾ x ⅝-in. plate, the plate being fastened to the base by long bolts and pipe spacers, as shown. Hardened steel bushings, 1½ in. outside diameter, are provided to guide the drill.

ENGINE TRUCK PEDESTAL CHUCK.

At the Silvis shops only the top end of the engine truck pedestal is machined, where it fits the frame. This work is done on a

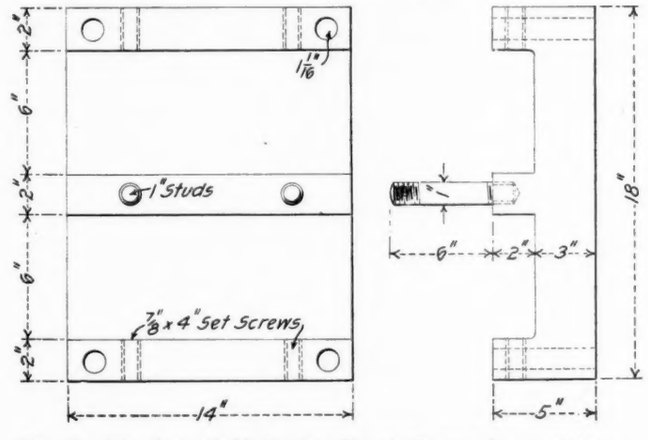


Fig. 2—Chuck to Hold Engine Truck Pedestals on Slotter.

slotter in a minimum amount of time by the use of the chuck shown in Fig. 2. The chuck holds two pedestals at a time, square with the cross-feed. The 1 x 6-in. studs clamp the pedestals to the chuck, and the chuck itself is bolted to the table by 1-in. bolts through the four 1 1/16-in. holes. In practice the pedestals are placed in the chuck and the four set-screws are set up by hand; the pedestals are then drawn down solid by two horseshoe clamps used in connection with the two 1-in. studs, after which the set-screws at the side are tightened with a wrench. In connection with the chuck a new tool post has been designed (Fig. 3). These tool posts fit the slots in the clapper and are set 6 in. apart so that two tools may be operated at the same time.

TOOL RACK OR TABLE.

A neat and serviceable tool rack for use in connection with machine tools is shown in Fig. 4. The top and shelves are of ¼-

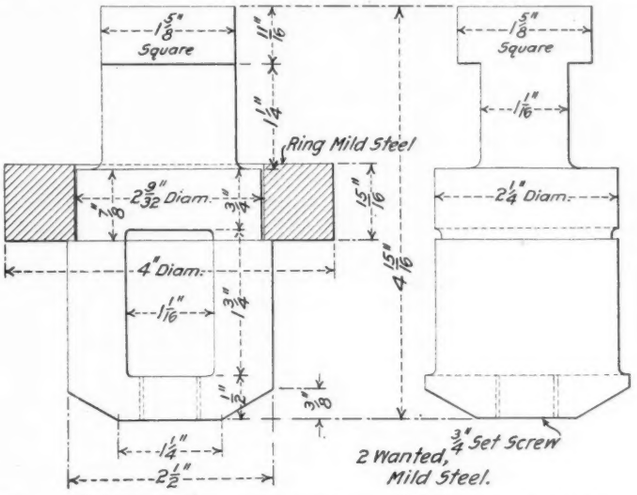


Fig. 3—Special Tool Post Used on Slotter for Machining Engine Truck Pedestals.

in. steel plate, the uprights being ¾-in. rods with ¾-in. pipe spacers. The drawer is constructed of No. 8 steel. The shop is equipped with a number of these racks, or tables, which have been found very useful.

RACK FOR DRIVER BRAKE RIGGING.

An inexpensive rack, which keeps the driver brake rigging off

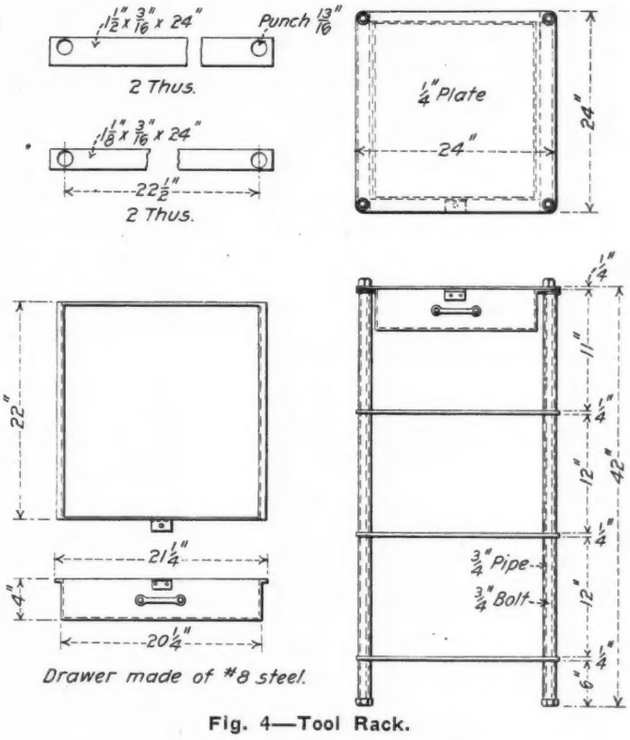


Fig. 4—Tool Rack.

the floor and economizes floor space, is shown in Fig. 5. The frame is constructed of 2½ x 2½ x ¼-in. angle iron.

BOLT WAGON.

As the iron is sheared to length for bolts in the smith shop it is piled on the wagon or cart (Fig. 6), and is moved to the furnaces, thus saving any rehandling.

STAMPING STEEL RUNNING BOARDS.

A special set of dies for stamping the projections on steel running boards, or steps, to prevent slipping is shown in Fig. 7. The dies are made of mild steel blocks, 15 x 19 x 2½ in. in size, and are fitted with forty-nine ¾-in. pins, as shown. The four springs, one at each corner, raise the top die after the sheet is stamped. The dies are used in a hydraulic sectional flanger.

DIES FOR CORNER PATCH FOR WASHOUT PLUGS.

Another shop kink used in connection with the hydraulic sectional flanger in the boiler shop is a set of dies for making corner patches for washout plugs. The male die is 5 63/64 in. in diameter and fits in the vertical ram of the machine; the lower die is 11 in. long, shaped at the top with a 5⅞-in. radius, as shown in the drawing, Fig. 8. A 1⅛-in. hole is drilled in the bottom end of the upper die and a taper keyway is cut through the die to hold the punch, which is 2 in. in diameter, in place. A ⅝-in. hole is punched in the sheet which is to form the patch, after which it is heated and placed between the dies. It is bent and the hole is flanged for the washout plug in one operation. After the dies have been closed the taper key is removed and the 2-in. pin is forced clear through the hole in the patch.

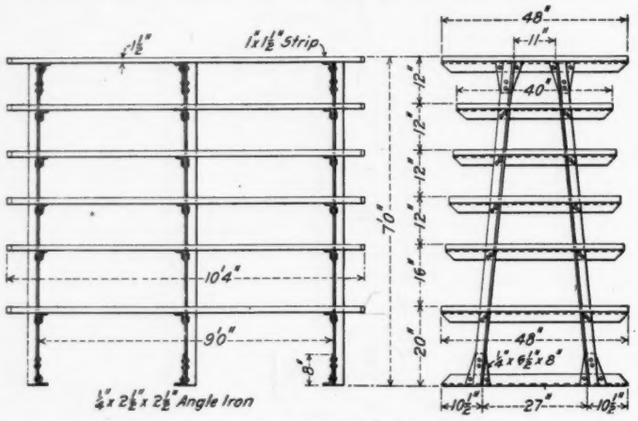


Fig. 5—Rack for Driver Brake Rigging.

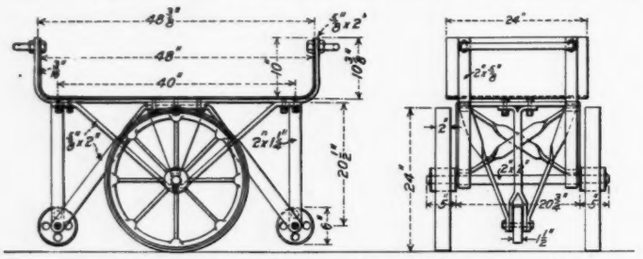


Fig. 6—Cart Used in the Manufacture of Bolts.

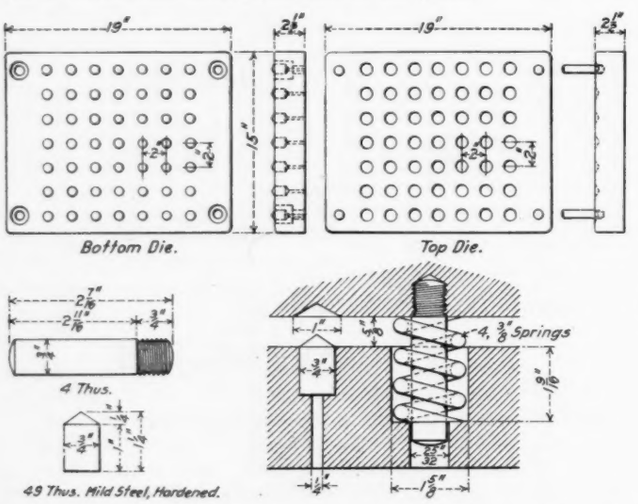


Fig. 7—Dies for Stamping Steel Running Boards and Steps.

OIL TANK FOR SPRING SHOP.

A handy oil tank for the spring shop is shown in Fig. 9. It is made of ¼-in. steel and is so constructed that a man can work both sides at one time. It has two compartments, the middle one for water and the outside one for the oil bath. A constant flow of water is maintained in the water compartment in order to keep the oil as cool as possible, the water entering through a 1-in. pipe coil and going out at one end through the 2-in. overflow pipe. A netting is suspended in the oil on each side to hold the plates while submerged.

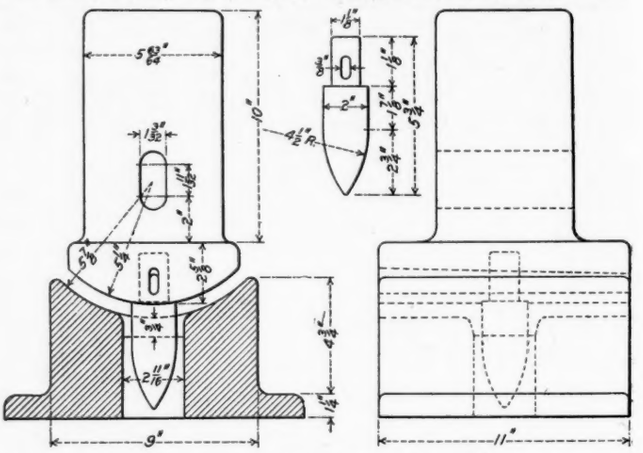


Fig. 8—Dies for Forming Corner Patch for Washout Plug.

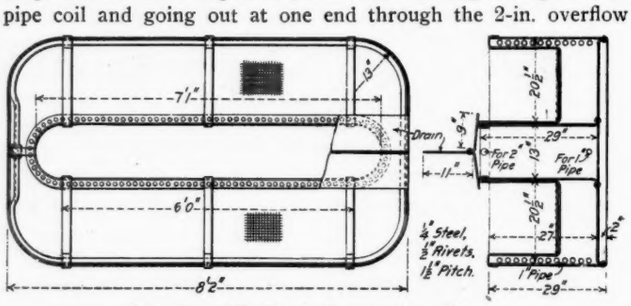


Fig. 9—Oil Tank in Spring Shop.

Kinks from Various Sources.

CUTTING HEAVY IRON UNDER STEAM HAMMER.

A device for cutting iron and steel bars which are too heavy

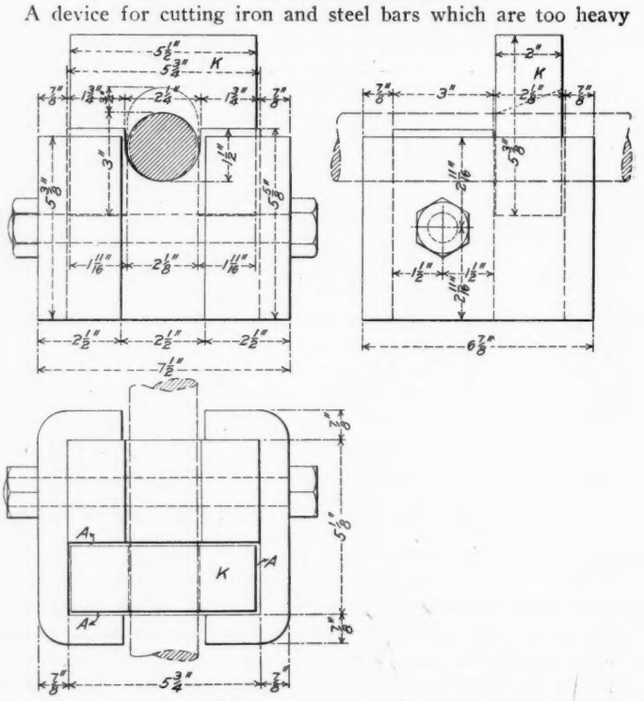


Fig. 10—Does for Cutting Steel Bars Under Steam Hammer.

for the light and medium size shears which are found in many of the smaller repair shops is shown in Fig. 10, and is used under a steam hammer. It consists of three parts, which are held together by the 7/8-in. bolt, and the steel knife, K. The device illustrated is used for shearing 2-in. round bars. The block has a semi-circular channel of 1 1/16-in. radius, in which the bar rests. One blow of the hammer on the knife shears the bar. Similar blocks and knives are used for shearing 4 x 3/8-in. and 4 x 1/2-in. spring steel in the locomotive repair shops of the United Railways of Havana at Cienaga, Cuba. We are indebted for the drawing and information to H. P. Riley, master mechanic.

PORTABLE BORING BAR FOR BELL FRAMES.

It is the practice in many shops to remove the bell frames from the locomotive when they require reboring and do the work on a drill press or a lathe. The details of a portable boring bar for this purpose, by which the frame may be rebored without removing it from the locomotive, and which has been used to splendid advantage in a large locomotive repair shop, are illustrated in Fig. 11. A fourth-year apprentice can usually rebore a frame in 1 hour and 15 minutes, including the time for setting up and taking down the boring bar; a first-class machinist can ordinarily do it in much less time. The caps shown in the upper left-hand corner of the illustration fit over the bosses on the frame, and may be adjusted for the proper alinement of the boring bar by means of the set screws. The caps are made of 5/16-in. boiler steel with 1/4-in. plates brazed in the ends, to carry the bar bushings, which are of brass and are shown in the lower left-hand corner of the drawing. The small handle is fastened to the top of the gear-case plates in order to steady the gear frame with one hand while the boring bar is being operated with the other. Just above the general view, showing the device applied to a bell frame, is a steel stud, a brass feed nut and, to the right of the nut, a peculiarly shaped piece of 1/4-in. steel. The stud is screwed into the cap at the left on the bell frame and holds the piece of 1/4-in. steel, which fits down over the slot in the feed nut on the end of the boring bar, thus providing for the feed while the bar is in operation. The three driving gears are of steel and have 16, 28 and 36 teeth, respectively. The description of this device was furnished by M. H. Westbrook.

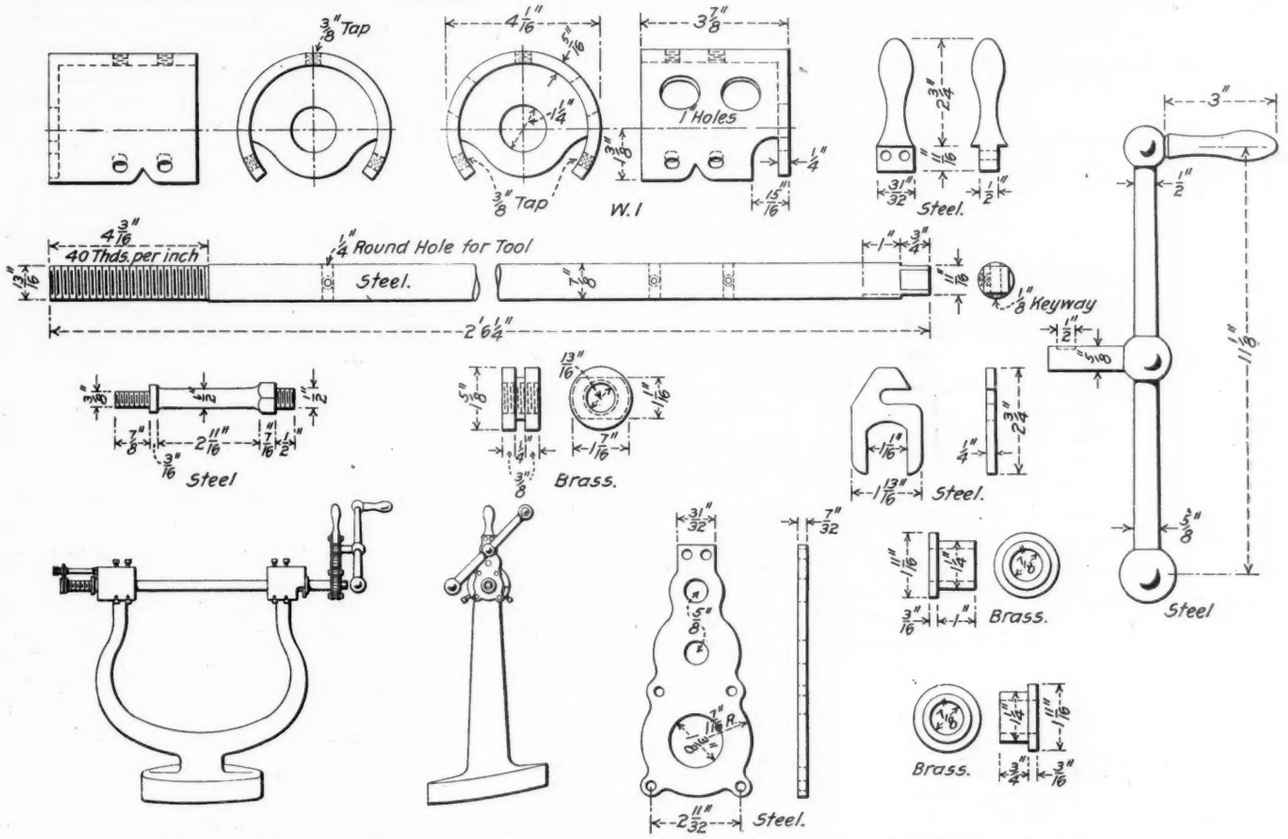


Fig. 11—Details of Portable Boring Bar for Reboring Locomotive Bell Frames in Place.

END TOOLS FOR LATHES.

A German machine shop is using an end tool for certain classes of work, such as centering and the like, that is handy,

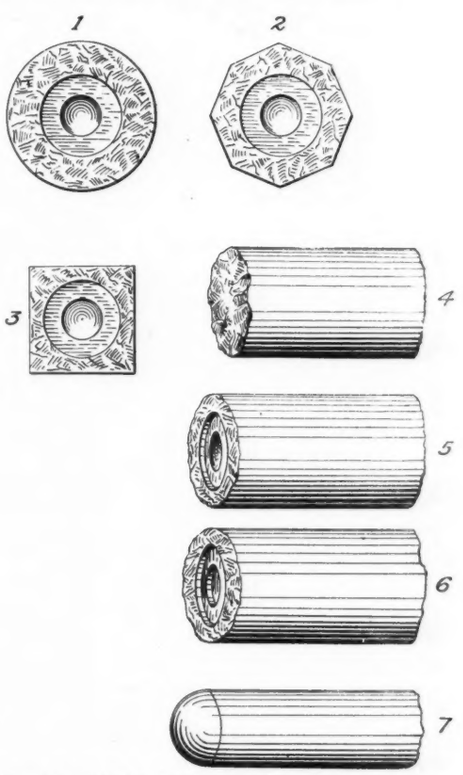


Fig. 12—Work Done by End Tool on Lathe.

easily used and capable of variations not shown in the sketches. It may be used in the case of stock that is to be worked off or centered, as shown in Fig. 12, Nos. 1, 2 and 3, showing round, square and octagonal sections, respectively; No. 4 shows the bar as it is broken off, No. 5 with the end milled and centered, No.

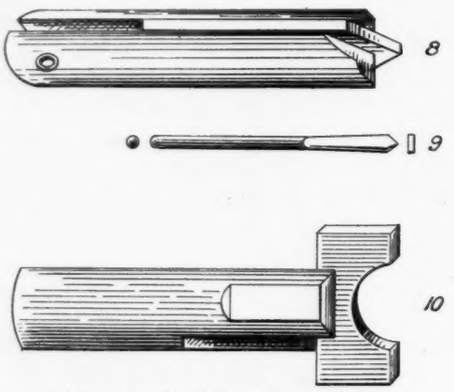


Fig. 13—End Tool for Lathes.

6 with the end milled and center bored; No. 7 is a small rod turned or milled with a hemispherical end to correct centers. One form of the tool which centers and end mills is shown in No. 8 (Fig. 13). There is a sliding center drill, which makes a 60-deg. countersink in the end, of a depth and diameter dependent on the amount of projection of the bit. The rest of the tool forms an end mill with two cutting faces. Where

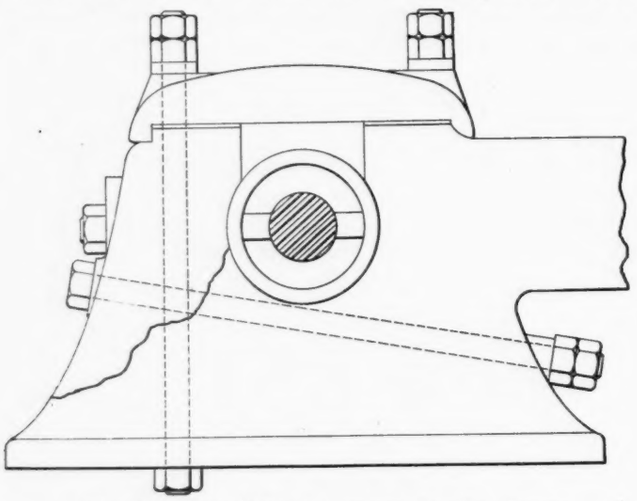


Fig. 14—Repairing a Broken Engine Frame.

center boring is desired the tool, instead of being slotted, is merely drilled to accommodate the small flat drill, No. 9. For ball milling, as in No. 7 (Fig. 12), the bit is made as shown in No. 10 (Fig. 13). The same holder may be used for either the countersink or ball tool.

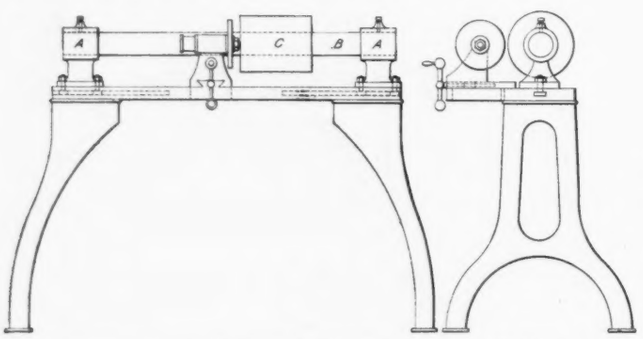


Fig. 15—Improvised Grinder for Milling Cutters.

REPAIRING A BROKEN ENGINE FRAME.

The acompanying sketch (Fig. 14) shows a method that was successfully shown in a railway shop some time ago for repairing temporarily the frame of a stationary engine that had broken away at the main bearing. Two diagonal bolts were run in through the lower part of the fracture and the front leg of the frame, as shown. Then a part of the foundation was cut away so as to get at the lower end of an extension to the cap bolt that was sent down through a hole, that was drilled, and screwed into a nut at the lower end. The cap bolt was replaced with this, and the whole was so firmly held together that the engine

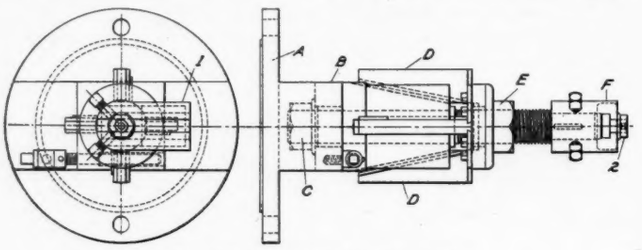


Fig. 16—Eccentric Mandrel.

could be worked to its full capacity until another frame could be made and fitted to place.

GRINDER FOR MILLING CUTTERS.

A certain shop bought a milling machine, which was used extensively, but had no accurate means of grinding the cutters. There happened to be a small lathe bed handy that had been discarded. The head and tail stocks were removed, and in their places brackets A A (Fig. 15) were placed. These were bored to take the mandrel B. A bearing with a shaft, pulley and emery wheel was attached to the carriage, that could be driven by an overhead drum. The milling cutter C, to be ground, was put on the mandrel and the latter clamped by the set screws in the brackets A. Adjustments were made by easing off on the screws and turning the mandrel. The traverse of the emery wheel was accomplished by hand through a feed screw, not

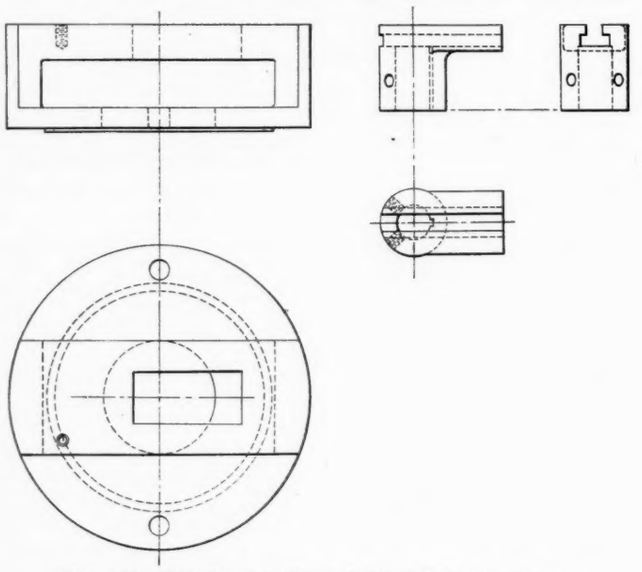


Fig. 17—Details of Way of Eccentric Mandrel.

shown, and the adjustment by the cross feed of the carriage. Rather crude for fine work, but it served its purpose for many months in a pretty big shop.

ECCENTRIC MANDREL.

The device for turning eccentrics, Fig. 16, combines an adjustability to care for a wide range of eccentric throws, quick setting of the work and rigidity while in operation. The base A is bolted to the faceplate and carries a way, or bearing, B, which extends across A. This way, Fig. 17, is really U-shaped, with

the two legs cast solid with the main body. The open portion serves as a space for the tightening nut C, of the expanding mandrel. The end of the mandrel is put in through a rectangular hole in the face of the way, and is held set in any desired position of eccentricity by the nut C. The mandrel is provided with the expanding jaws D D, which move to and fro in the grooved guides in the usual manner, and are held out to the work by the nut E. With the eccentric set over the mandrel and held in this way there is considerable overhang, and on heavy work there would be apt to be a good deal of chatter. To obviate this and hold the work steady, a collar F, is slipped on over the end of the mandrel stem. This collar has a side projection or overhang, I, extending out on one side and in which there is an undercut way (Fig. 17). This overhang and its way are held in line with the main way, B, of the base by a key, and carries a small slide, 2, which may be clamped in any position by a nut. By setting 2 with the same offset, but in the opposite direction that is given to the mandrel itself, it offers a center bearing for the tailstock, so that the latter can be brought up against the work, and the mandrel can thus be securely supported.

In turning the eccentric the work is done just as though it were held on a solid mandrel carried at its ends by the head and tail stocks. For setting or removing the work it is simply necessary to drive out the key holding the collar F in place, back off the tailstock and slip the eccentric over the end of the mandrel. Another eccentric can then be put in place and clamped by setting up the nut E and keying on the collar F. With the device as shown eccentrics with throws ranging from 0 to 6 in. can be turned, and the adjustment from one to the other is easily and quickly made.

CAR REPAIR SHOP NOTES, NEW YORK CENTRAL & HUDSON RIVER AT EAST BUFFALO.

Extensive repair shops for both freight and passenger cars are maintained at East Buffalo, N. Y., by the New York Central & Hudson River. Heavy repairs are made to mail, baggage and horse cars, and light and running repairs are made to other classes of passenger equipment. Coaches which lay over at Buffalo are cleaned at East Buffalo. In addition to wooden freight cars a small number of steel cars are repaired, although with the exception of a few tools no special equipment has been provided for this work. A large amount of material is also manufactured at the shops for use on the division. Practically all of the work is done on a piece-work basis, including the work of the sweepers, cleaners and laborers. During March, 1910, about 450 men were employed, 360 of them being engaged strictly on car work, the others being connected with the store department, office force, etc. Heavy repairs were made to 422 cars of all classes.

The weather in the vicinity of Buffalo is severe and stormy during the winter months and plans are being made to extend the car repair shop so that all of this work may be carried on under cover. An addition 400 ft. long is to be added to one side of the shop this summer and another of the same size will probably be added to the opposite side next year, making the completed shop 300 ft. wide and 1,000 ft. long. We are indebted for assistance in collecting information for this article to W. O. Thompson, master car builder; Wm. Shone, general foreman; F. Deyot, Sr., assistant general foreman, and F. Deyot, Jr., apprentice instructor.

APPRENTICE SCHOOL.

At the recent meeting of the Master Car Builders' Association, J. J. Hennessey, master car builder of the Chicago, Milwaukee & St. Paul, in speaking on the consolidation of the M. M. and M. C. B. Associations, said: "The crying need is to interest more young men in the car department. I believe I voice the sentiment of nearly every man of experience in this hall when I say it is almost impossible to-day to find young men who have the proper training to take charge of a large car shop. Why? For the reason that for years the opportunities for young men to come in and learn the car trade have not been as good as they have been in the locomotive department. The result has been that the brightest young men have drifted into other departments, and the car department to-day is really at a loss to conduct its business as it should be conducted." This fact was thoroughly realized when the New York Central Lines adopted its new apprenticeship system in the spring of 1906 and provision was made for interesting and instructing the car shop apprentices at all points where schools were established. Schools were, however, placed only at the more important shop points and naturally greater stress was given to the work of the locomotive department. The car repair shops at East Buffalo are entirely separate from the locomotive repair shops, which are located at Depew, a number of miles distant. The school established at East Buffalo in August, 1906, was, therefore, for car shop apprentices only and was the first school established in this country for such apprentices based on modern apprenticeship methods.

The establishment and development of the school has not proved an easy task, but, judged from a practical standpoint, its work thus far has been successful; if all goes well the first apprentice to complete the four years' course will be graduated next September and the second one will complete his course in December. The experience of the past few years has developed the weak points in the system, all of which it will be possible to strengthen. It was predicted by many when the school first started that it would be a failure. They argued that there was not enough opportunity in a car shop, where practically no passenger car work was done, to hold the boys; that the equipment of the various departments, with the possible exception of the planing mill, is not extensive; that the apprentices would leave when they were forced to work in the repair yard during unfavorable weather, and that the rate of pay would be too low to hold them. There is more or less truth in all these arguments and it is also true that a high degree of skill is not required in the freight car repair shop and yard; but, on the other hand, men have never been thoroughly and systematically trained for this work and the greater service required of the cars and the wonderful development in car interchange have opened splendid opportunties to bright and ambitious young men who intend to make a specialty of car department work and are willing to work hard.

There were so few apprentices available when the school was started that the young handy-men and laborers were given an opportunity of attending the classes. These men have gradually dropped out, but apprentices have been added. Buffalo is an important manufacturing center, and the greatest difficulty has been that the boys do not look far enough ahead and often leave because they can get a little better pay elsewhere. With the extension of the shops, so that practically all of the work can be done under cover, and the moving of the school into better quarters, it is thought that still better results will be attained in holding the boys.

At present there are eleven regular apprentices, including two in the fourth or last year, two in the third year, three in the second year and four in the first year. They are learning the following trades: Tinsmith, two; machinist, five; carpenter or freight car repairer, three, and planing mill, one. There are two classes, each of which meets two mornings a week, from 7.30 to 9.30. The drawing course for the first few months is the same as followed by all shop apprentices on the New York Central Lines. It consists largely in redrawing correctly sketches which are not in scale, the dimensions being taken from models. These objects are in all cases selected from those with which the boys come in contact in the shop, the work being thoroughly practical from the very start. New principles are introduced gradually and one at a time as the work advances. After the first or general exercises are completed the apprentices are required to make rough sketches in their note books of simple car parts or castings, a supply of which are kept in the classroom. With these rough sketches as a basis accurate

mechanical drawings are then made on the drawing board. As the student advances, more and more difficult or intricate parts are assigned to him.

The problem course is practically the same as that used for the other trades. The problems, like the drawings, are based on shop practice and company standards. The first ones are very simple, but they gradually grow more difficult. The simple principles of algebra, geometry, physics and elementary mechanics are introduced as they are needed, but are not classified or spoken of as such. Whenever possible suitable apparatus is used to check or to explain the problems more fully. A good

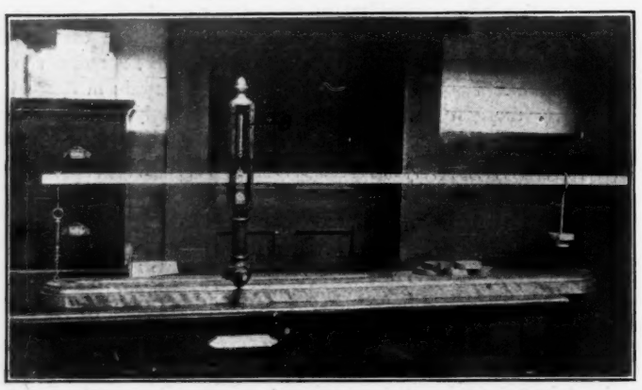


Fig. 1—Apparatus for Demonstrating Leverage Problems.

example of this is the apparatus illustrated in Fig. 1, which was designed at East Buffalo for demonstrating problems in leverage and is an improvement over similar apparatus in use at the other schools. Two small spring balances, A and B, of 15 lbs. capacity, are arranged as shown. These balances may be adjusted to a zero reading. By hanging weights on the end of the stick and adjusting the length of the arms, the reactions at the fulcrum and at the opposite end may be checked with the results of the calculations.

To give some idea of the problem work a few instruction and problem sheets on "Leverage" have been selected at random from different parts of the set and are reproduced as follows:

General Classroom Problems. Sheet No. 1029.

LEVERAGE.

(Study this sheet carefully and keep it for reference.)

By lever is meant a bar of any shape, either straight or bent, which is free to turn about a fixed point called the fulcrum. A fulcrum may be any form of round bearing or stationary prop or support.

Levers are divided into three classes according to the relative positions of the fulcrum and the weights with which they are loaded. In the first class the fulcrum, F (Fig. 2), is between the power, P, and the weight, W.

Fig. 2.

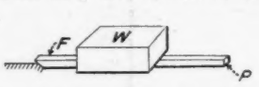


Fig. 3.

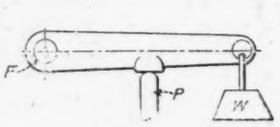


Fig. 4.

In the second class the weight is between the power or force, and the fulcrum (Fig 3). In the third class the power or force is between the fulcrum and the weight (Fig. 4). In all three classes the rules or laws of the lever are the same.

Force and power mean the same thing. A force may be either a push or a pull. Power or force may be obtained in many ways, such as by steam, air or water pressures or through a weight acting downward. In the case of a machine the force applied to it to set it in motion is called the power and the resistance to be overcome is called the weight.

General Classroom Problems. Sheet No. 1030.

Name..... Date.....

(Fill in the answers on this sheet with a soft pencil where indicated. Make all figures carefully. When all answers are filled in, return sheet to instructor for correction.)

Go to the laboratory and set up the leverage model for a first-class lever as shown in Fig. 5. Place the stick on the fulcrum block so that a weight of 4 lbs. can be hung 24 in. to the left of the fulcrum as shown. Place the other weight holder 32 in. to the right of the fulcrum and add weights until the stick swings down level and both ends balance.

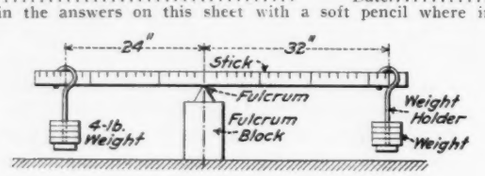


Fig. 5.

1. What weight did you add to make the balance? Ans.. .....lbs.

2. Place a 6-lb. weight 18 in. to the left of the fulcrum and add weights to the holder located 24 in. to the right of the fulcrum. How many pounds are needed to balance?. Ans. .....lbs.

3. Suppose we know the weights to be 3 lbs. and 4 lbs., and the 3-lb. weight was 28 in. to the right of the fulcrum. Find by trial how far to the left of the fulcrum the 4-lb. weight should be placed to make the stick just balance. Ans. ..... ins.

General Classroom Problems. Sheet No. 1043.

(Study this sheet carefully and keep it for reference.)

Fig. 6 shows the model arranged for a lever of the third class. A third-

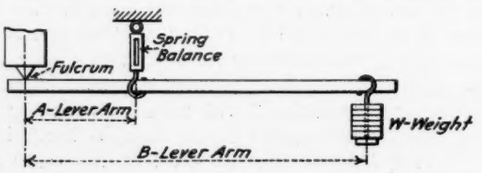


Fig. 6.

class lever like the second class has the fulcrum at one end and the weights pulling in opposite directions. The difference between a third and second-class lever is in the location of the weight and the spring balance.

As with the first and second-class levers the moment of the weight times its distance from the fulcrum must be equal to the moment of the pull on the spring balance times its distance from the fulcrum, when the stick is level and balanced.

The same error in figuring results will be found with this lever as was found with the second-class lever; that is, the weight of the stick and weight holder must be deducted in order to check the results obtained by arithmetic. Suppose that when no weights are on the holder the reading of the spring balance is 3 lbs. (Fig. 6). If we put 4 lbs. on the holder and then find the spring balance reads 11 lbs., this means that we must subtract 3 from 11 in order to get the correct weight, or 8 lbs.

General Classroom Problems. Sheet No. 1044.

Name..... Date.....

(Fill in the spaces left blank in the table below by trying the different weights placed on the leverage model arranged for a third-class lever as shown in Fig. 6. Make proper allowance for weight of stick and holder in each case. Prove the results by arithmetic.

A	B	W	P
15	30	8	.....
15	60	.....	2
18	24	.....	2
7	28	8	.....
15	60	8	.....
12½	50	.....	2
14	35	.....	2½
9	27	.....	3
20	60	6	.....
16	32	10	.....

General Classroom Problems. Sheet No. 1054.

Name..... Date.....

(Fill in the answers on this sheet and return to the instructor. Do the work on the blackboard.)

It is plain that with a third-class lever the movement of the points of application of the forces or weights will be the same as for a second-class lever. The diagram of similar triangles will also be the same and we must simply remember in each case whether we want the movement of the point of application or the point of delivery of the power. The only difference be-

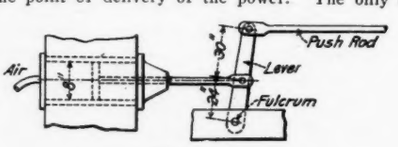


Fig. 7.

tween a second and third-class lever is that in the second class the power is applied farthest from the fulcrum and in the third class the power is applied nearest to the fulcrum.

1. Fig. 7 shows a tender brake rigging operated by an 8 in. by 12 in. air cylinder. If the piston moves 8 in., how far will the push rod move? Ans. .....

2. Draw the similar triangle diagram for Problem 1 on the backboard and mark plainly all dimensions and distances moved. .....Instructors O. K.

3. If the air pressure in the brake cylinder was 90 lbs. per sq. in., what would be the force transmitted by the push rod? Ans. .....

4. What class lever is this? Ans. .....

A model is just being completed which will assist the boys in grasping more thoroughly the principles of freight car construction and design. It is a 36-ft. box car built to a scale of 1½ in. to the foot. As shown by the accompanying illustrations, Figs. 8 and 9, one end and one side of the car are only partially finished, showing the construction of the framing of the car in detail. The metal parts are all hammered to shape from brass plate and are exactly to scale. It is planned to secure small truck models and to build a separate model of the foundation brake gear on a larger scale.

General Car Apprentice.—The East Buffalo car shops also

have what is termed a general car apprentice. The young man is a university graduate and intends to put in four years studying car repair work. He will spend six months each in the blacksmith shop, machine shop, planing mill, carpenter shop and air brake department. During the last year-and-a-half he will work is done. The rods are brought in at the end of the shop on a special steel cart for handling bar iron, shown in Fig. 10. Two men feed the rods to the double shear shown at the left in Fig. 11, while a third man piles the pieces on the cart shown in Fig. 12, and also in Fig. 11, at the same time counting them.

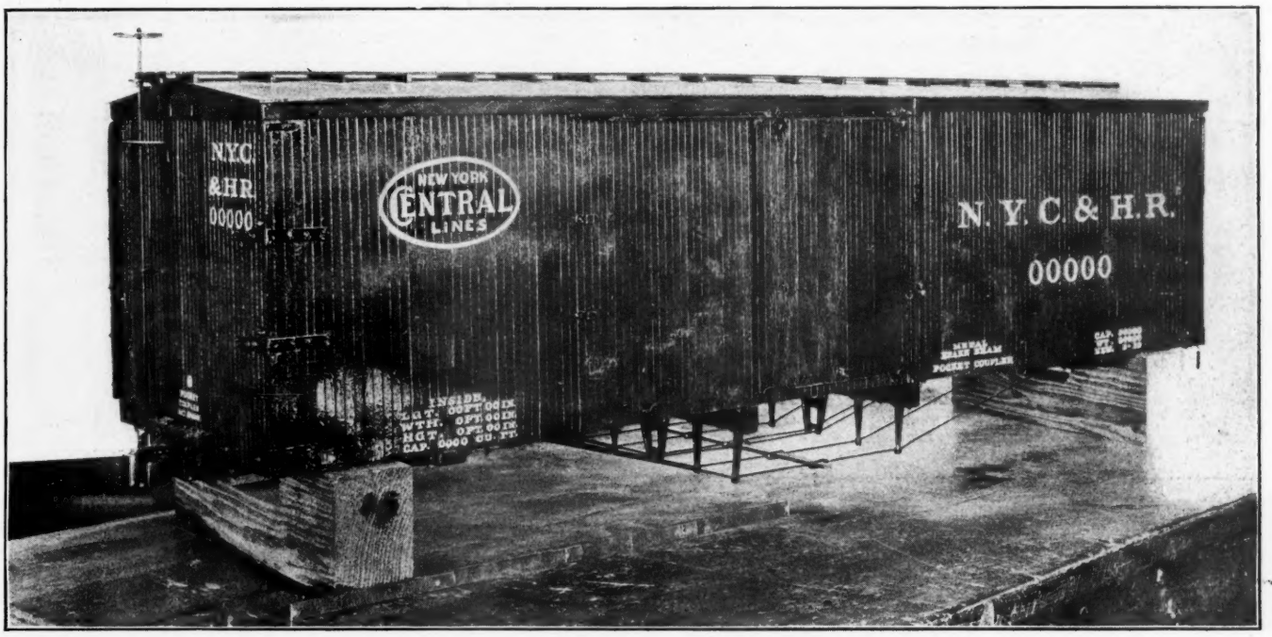


Fig. 8—Model of Standard Box Car for Use in Apprentice School.

assist the foremen, piecework inspectors, etc., becoming familiar with the work done by these men. He attends the apprentice school with the regular apprentices, taking the same work as they do.

MANUFACTURING BOLTS.

A number of improvements are being made in the routing and

One of these carts will hold 5,000 pieces for ⅝-in. bolts. The cart is moved to one of the three Ferguson oil furnaces where the rods are heated, after which they are forged in either the 2-in. Blakeslee or the 1½-in. or 1-in. Acme forging machines. As the heads are forged the bolts are thrown into the bolt cart, shown in Fig. 13. They are then moved down the line to one of

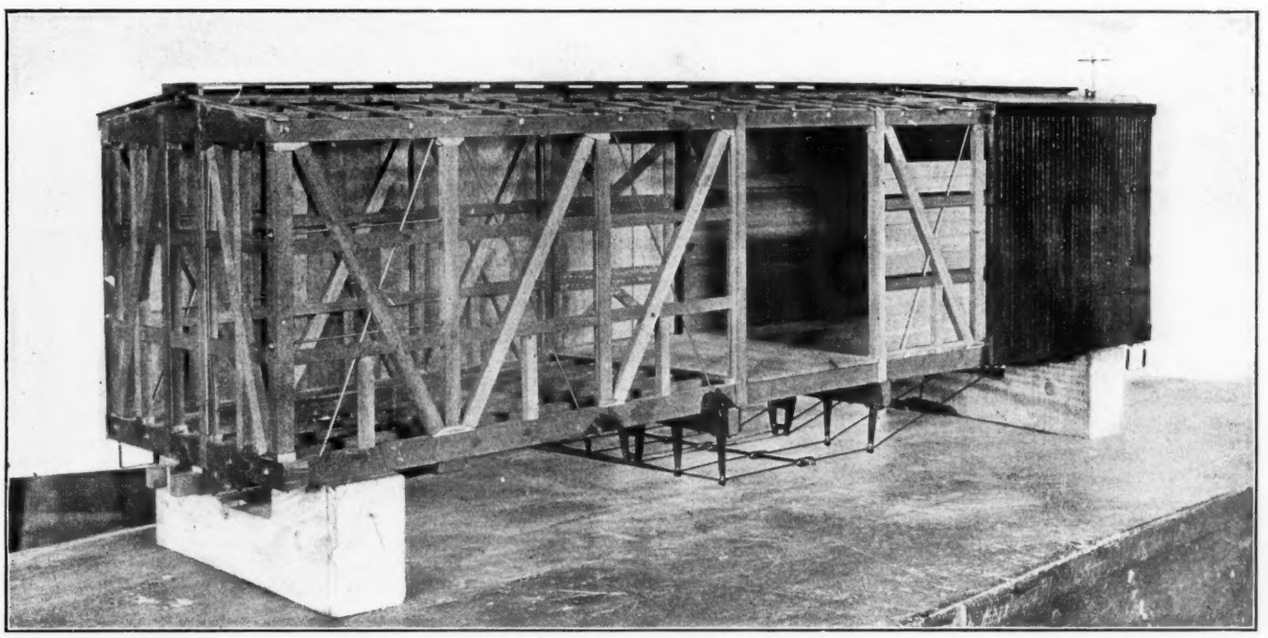


Fig. 9—Another View of Model of Box Car for Use in Apprentice School.

handling of work in the various departments, the most important change being in the manufacture of bolts in the blacksmith shop. To facilitate the handling of the carts in which the bolts are transported in the various stages of manufacture a concrete floor has been laid on the side of the shop where this

the six double head bolt cutters. A large number of bolts are also reclaimed from scrap by cutting them to shorter lengths and rethreading them.

PAINT STORAGE.

Paint is emptied from the barrels into 100-gal. tanks in the

paint storage building. The barrel is grasped at the ends by the hooks (Fig. 14) and is hoisted through an opening in the platform above. A specially designed truck, operating over rails on the platform, is run under the barrel, which is then lowered on the truck, resting on four rollers. The truck is moved over the tank in which the paint is to be emptied and the barrel is

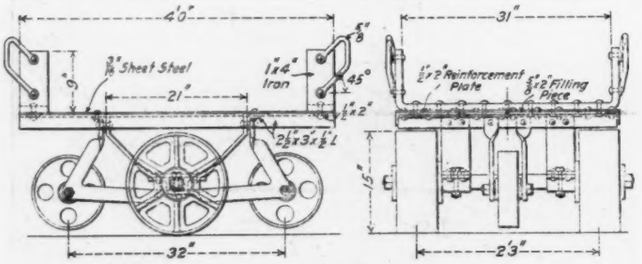


Fig. 10—Steel Cart for Handling Bar Iron.

rolled on the four rollers until the bung is at the top. This is knocked out and the operator, holding a piece of waste over the hole, turns the barrel until the opening is just above the tank when he removes the waste. The air cylinder for hoisting the barrels is 12 in. in diameter and has a stroke of 36 in. The platform is 8 ft. above the floor. The paint in the storage tanks is continually agitated, so as to be ready for use at all times, by the introduction of compressed air at the bottom of the tank through ⅛-in. holes spaced 5 in. apart in the air pipe.

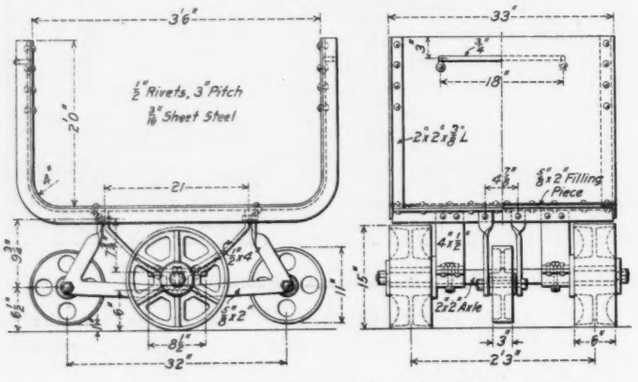


Fig. 12—Steel Cart for Iron Cut to Length for Bolts.

REPAIRING STEEL CARS.

Only a comparatively small number of steel freight cars are

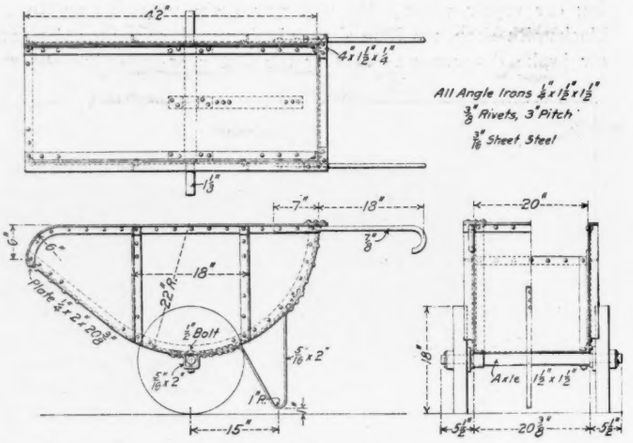


Fig. 13—Bolt Cart.

repaired at East Buffalo and very little special equipment has been provided for this work.

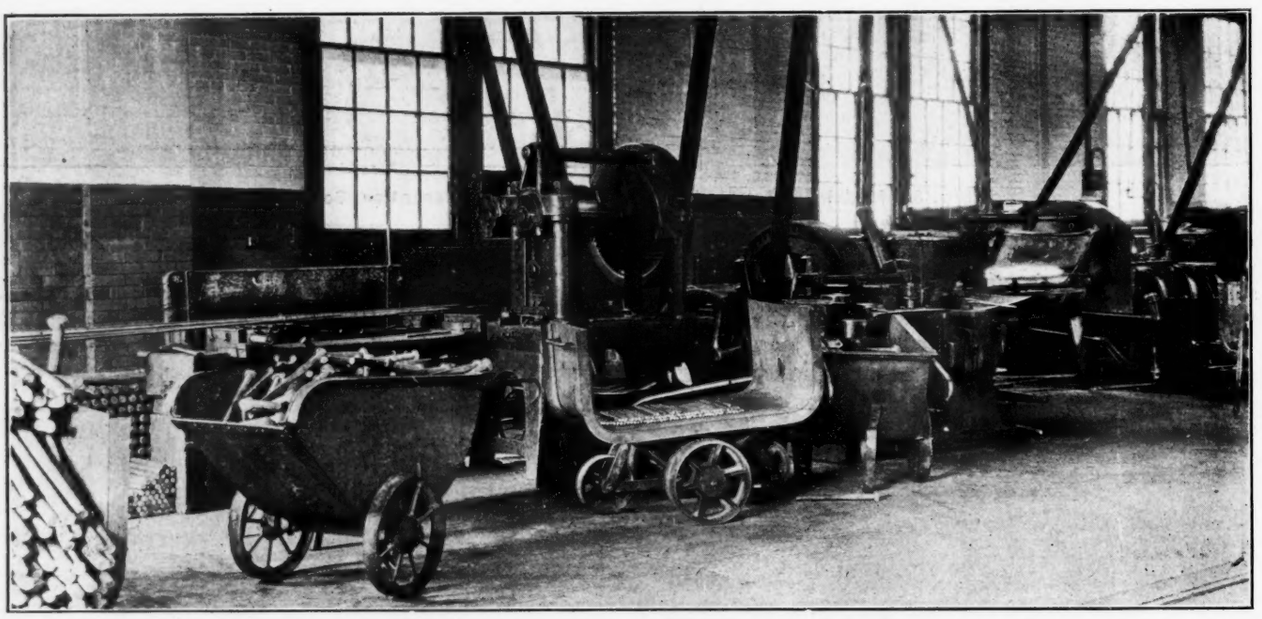


Fig. 11—Partial View of the Bolt Manufacturing Side of the Blacksmith Shop.

Rivet Heating Furnace.—The portable rivet heating furnace (Fig. 15) is somewhat more elaborate than the home made heaters ordinarily used for this work on most roads. The top is 26 x 26 in. in size and the ⅛-in. sheet on the three sides is 13½ in. high. The wheels are 16 in. in diameter and the handles are constructed of 1-in. pipe. Draft is provided by coupling to the compressed air line.

Portable Tool Box.—The men engaged in steel car repair work keep their tools in special portable tool boxes, as shown in Fig. 16. They are constructed of heavy galvanized iron, the box or house measuring 33½ in. in length, 2 ft. in width and 2 ft. in height. The door opening is 14 in. square, the door being secured by a padlock when the box is not in use. The wheels are 16 in. in diameter. The tools include cold chisels, sledge and hammer, drifts and wrenches; also pneumatic hammers, etc.

CAR DOOR TRUCK.

A simple and handy truck (Fig. 17) is used for handling car doors about the yard. The door sets between the metal guides on the truck and one end wedges between the two parts of the

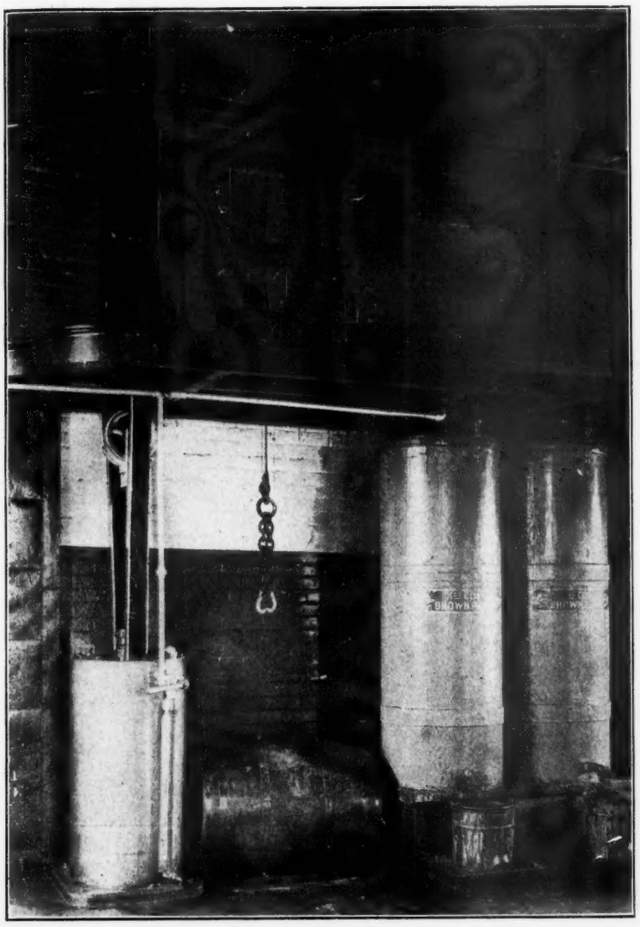


Fig. 14—Paint Barrel Hoist.

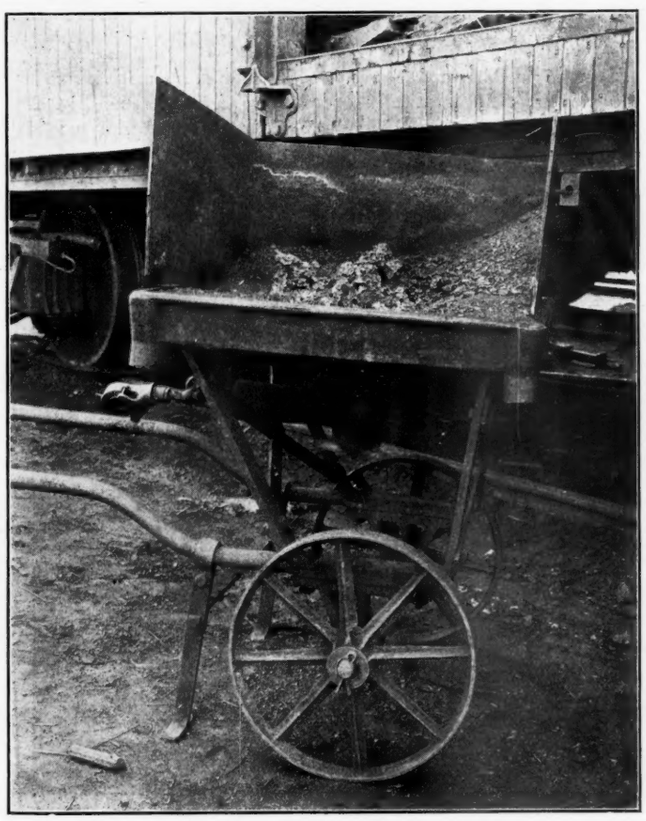


Fig. 15—Portable Rivet Heater.

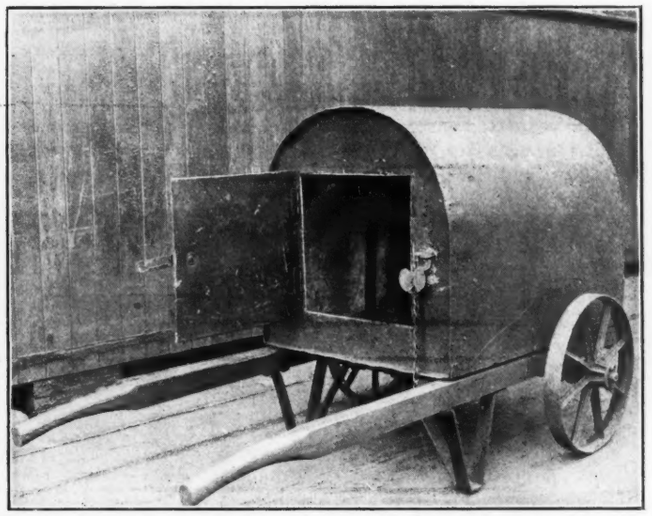


Fig. 16—Portable Tool Box for Steel Car Repair Gang.

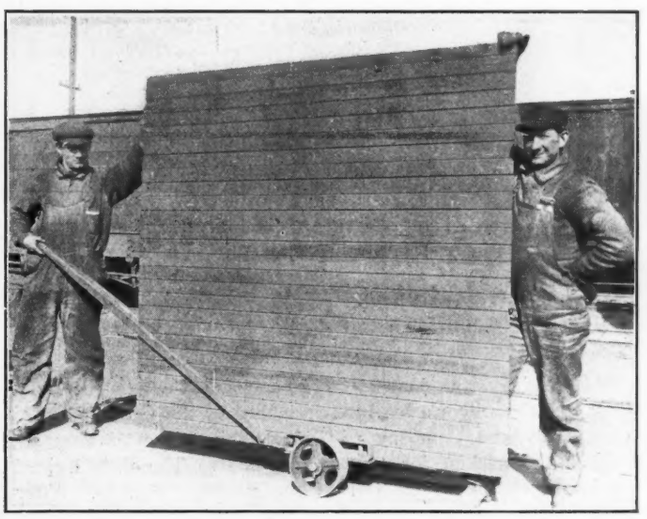


Fig. 17—Box Car Door Truck.

Fig. 18—Cart for Journal Box Packing.

wooden handle. The guides are constructed of ⅜ by 2-in. iron, as shown, and are bolted to the ¼-in. plate at the bottom, which is 6 in. wide and about 16½ in. long. The wheels are 9¾ in. in diameter.

ROPE TRUCK.

A special cart, Fig. 18, is used in connection with the repacking of journal boxes. The wooden box is lined with galvanized iron. The old packing is pulled out of the journal box and

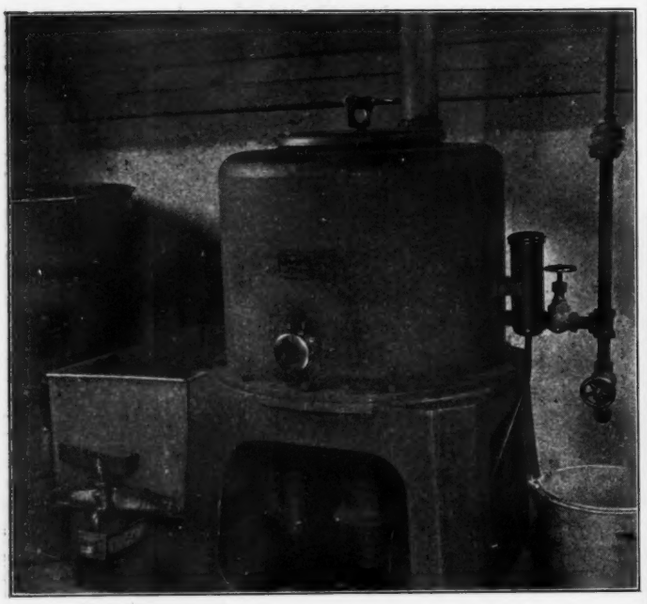


Fig. 19—Machine for Cleaning Journal Box Packing and Reclaiming the Oil.

dumped into one end of the cart; fresh waste for repacking is taken from the other end.

CLEANING JOURNAL PACKING.

Old packing from journal boxes and soiled waste from the shops are cleaned in a machine furnished by the Oil and Waste Saving Machine Company of Philadelphia. The packing remains in the machine for three or four hours. The oil is drained off into the tank at the left of the machine, Fig. 19. After being removed from the machine the packing is placed on an incline with steam pipes underneath, where it remains for about 18 hours while the oil and moisture in it are drained off and the packing is dried out.

GUARD ON VARIETY MOLDING MACHINE.

The most dangerous machine in a wood-working shop is the

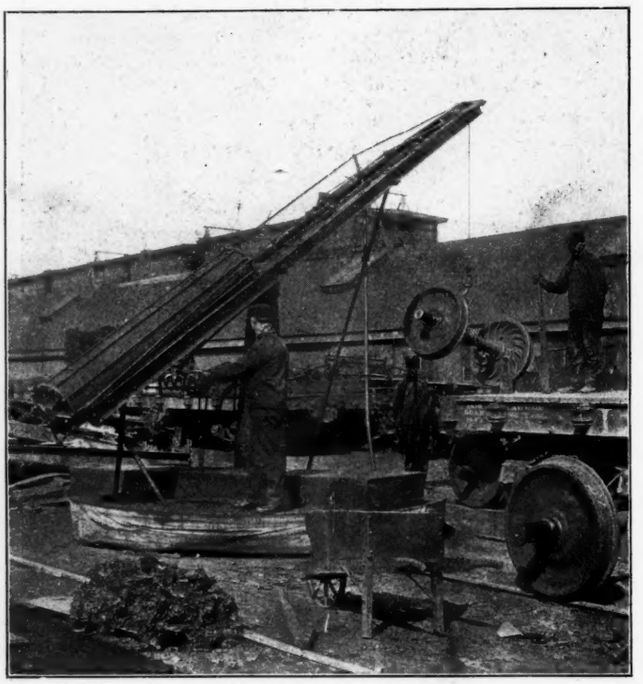


Fig. 21—Pneumatic Revolving Crane.

variety molder. A pair of safety guards which may easily be adjusted for any class of work and which also act as clamps or guides for holding the work down while it is being passed over the cutter is shown in Fig. 20. This device was furnished by the American Wood Working Machinery Company.

CRANE FACILITIES.

Several portable cranes are used for handling material about the plant. A pneumatically operated revolving crane, Fig. 21, is used for loading and unloading the heavier material such as wheels, trucks, bolsters, etc.

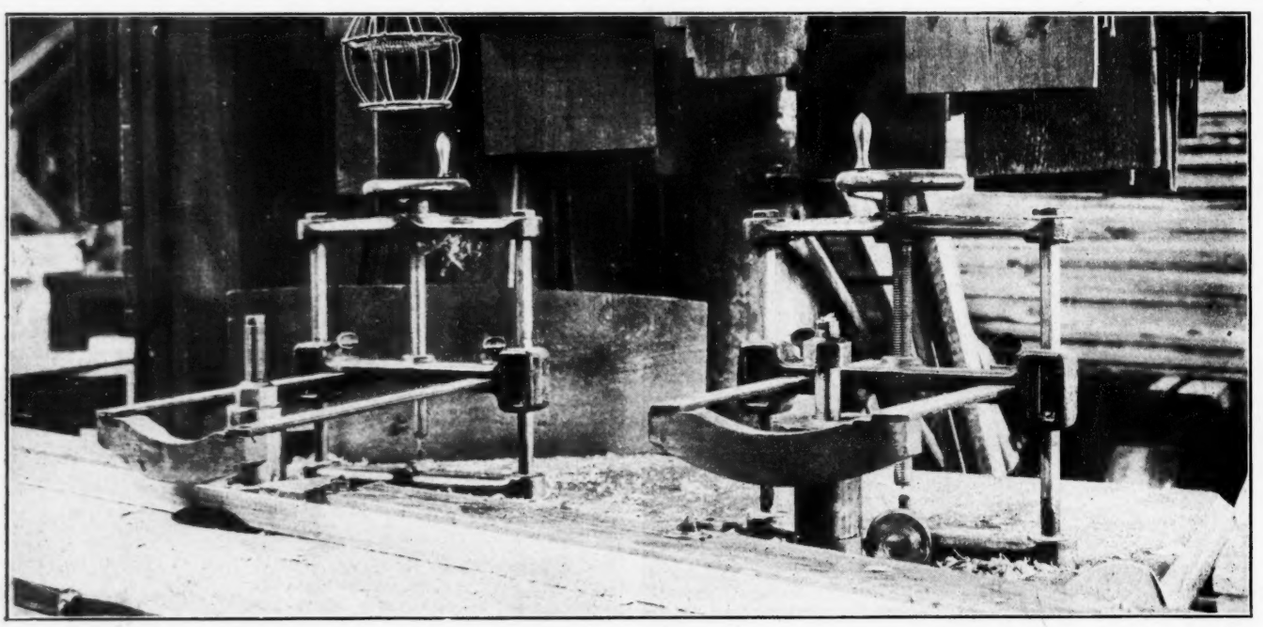


Fig. 20—Safety Guards and Clamps on Variety Molder.

RAILWAY TOOL FOREMEN'S CONVENTION.

The second convention of this association was held at Hotel Victoria, Chicago, July 12, 13 and 14, 1910. The meetings were fairly well attended and a good program was provided, considering the fact that the association was only organized last December. In the absence of the president, F. J. Powell, formerly of the El Paso & Southwestern at El Paso, Texas, the first vice-president, M. H. Bray, of the New York, New Haven & Hartford, New Haven, Conn., presided. The first paper, The Tool Room Check System, was prepared by the secretary, O. T. Harroun, tool foreman of the Chicago & Alton, Bloomington, Ill.; an abstract of it follows:

TOOL ROOM CHECK SYSTEM.

The tool room check system is the only way to keep a correct line on your tools. It is an endless task to inculcate in the minds of help the importance of being ever watchful in order that it will be known at all times just who has the tools. The most rigid discipline does not always prevent errors from creeping in. The tool room must have the co-operation of the gang foremen and the office in this matter. It is important that all tools be returned to the tool room every night. Where men leave the tools on the job over night some of them find their way to the night roundhouse men's private kits and never get back to the tool room. The tools disappear one by one. It would be well to have every man in both back shop and roundhouse open up his cupboard for inspection once every six months. I have known some rich hauls to be made under such circumstances. You can attribute the absence of a lot of tools to selfish gang bosses. Often one tries to outdo the other and encourages the men to "cop" tools for his gang. The only way to overcome this very unpleasant practice is to have all tools returned to the tool room every night before quitting time. It is a money saver, but it is hard to convince the management on this subject because of the time it takes to bring them in.

I have, in a large glass case, every man's name and number and a corresponding number with a pin for checks so the helpers can bring in the tools and the checks can be placed on the man's number and returned to him when calling for tools the next day. I divide the different men in groups; the machinists from 1 to 300, boiler makers beginning with 400, etc. Get the general foreman to understand that the tool room is the barometer of the shop rather than a non-producer. By being able to produce a tool with despatch when it is called for, time and labor are saved and money is earned for the company. When a man leaves the service he must have a tool clearance or he cannot get his time.

Discussion.

One of the members stated that at his shop each mechanic and helper was given six checks. All tools are supposed to be turned in every Saturday night. If not, on Sunday morning the man in charge takes the numbers of checks against which missing tools are charged and turns them over to the gang foremen, who advise the men as follows: You will have to square yourself with the tool room or quit work."

Each man gets a set of small tools when he is employed. We have a printed form, giving the list of tools, which each man has to sign before he goes to work. When he quits he turns his tools in. If they are not all returned the missing tool is checked off and he must settle the matter at the office.

W. J. Eddy (Erie):—All the tool rooms on our system are under the general direction of a tool room supervisor. We give each man six checks when he goes to work; he signs a receipt for them and agrees to pay 25 cents for every check he loses. The tools are issued from the tool room in the ordinary way and have to be turned in every evening. If they are not the man's check and name are sent to the general foreman's office and in the morning he is not permitted to go to work, but is given one hour to explain why he did not turn the tool in, and is compelled to turn it in before he starts to work. When a man quits he must have a tool room clearance, signed by the tool room foreman, before he is given his check.

TREATMENT OF HIGH SPEED STEEL.

August Meitz, tool room foreman of the Pere Marquette at Grand Rapids, Mich., in discussing the treatment of high speed steel said:

Steel is often burned in making tools to such an extent that it is practically worthless. In the hardening process this same difficulty is frequently experienced: The blacksmith often brings the point to a dripping heat, and then puts it under an air blast pressure of 100 lbs., or thereabouts, which many times results in a portion of the point flying to pieces, and the remaining portion resembling a lump of cinder more than a tool point; when the machinist gets the tool he is compelled to grind from fifteen to thirty minutes to bring it to a proper point, but in most cases the tool is then too blunt to be used very long. If the tool dresser would harden the steel in oil, he would have much better results. As milling cutters, drills and reamers are machined the edges must not be burned, but the steel should be heated to a bright, almost white heat, and dipped into oil; then it should be taken out quickly and brought under a sharp air blast. This I have found to be the best process of hardening air hardening steel to keep the shape and edge, as in ordinary shops there is no pyrometer to regulate the temperature, which should be about 2,200 degrees Fahrenheit.

Discussion.

E. J. McKernan (Santa Fe): The Topeka tool room has an electrical furnace and an American gas furnace for high heat and preheating. With the Blue Chip steel we get the best results at 2150 deg. Fahr. We preheat to 1400 deg. Fahr. Then when you place it in the electrical furnace it is pretty well soaked through and absorbs the high heat; when you drop it in the barium chloride, you can let it stay as long as you want to. The air in the compressed air lines contains a certain amount of moisture which cracks the tools. Since we have taken the blast from the blacksmith shop we have had no trouble.

O. T. Harroun (C. & A.): I have been getting beading tools from the blacksmith shop, which were invariably so hard that my tools would not hold up in working on them. I told the master blacksmith he would have to devise some means of getting these tools so I could work them. Within the past two weeks he brought me a piece of steel and said: "Well, I have devised a means of stopping your kick on the annealing of high speed steel." He used the scale that comes off of the forgings at the big hammer. It was put in the box with the work in it and then placed in the furnace.

Question.—Doesn't it carbonize any?

Answer.—I do not know; I have not ground any of it.

H. Derby (Santa Fe): I have tried something along that line. I put the steel in the furnace; bring it up to a red heat and put it in a pipe full of pine sawdust. Put it in the center of a box and seal it up with fireclay and let it cool off.

Mr. Robinson: Take a piece of pipe of sufficient size to accommodate the steel; screw a cap on one end; fill up with sand; stuff the tools down in the sand; screw the cap on; put it in the furnace and let it heat up. You can pull it out if you want to use the furnace for anything else, or you can leave it in the furnace over night. Take it out the next morning, and you will find it well annealed. We have not noticed any difference in the steel after being annealed this way; it seems to do the same work and lasts just as long. I think the whole secret is to keep air from it.

Mr. McKernan: We have used the sand, but it must not have any moisture in it.

Mr. Bray: At New Haven we use slack lime. We heat our high speed steel to a dark red; at the same time heat two pieces of flat iron to a white heat and place the high speed steel between them before placing in the lime.

Tool Room Practice on the Santa Fe.

E. J. McKernan, tool room supervisor of the Santa Fe, described the practice on that system, as follows: The tool room is of as much importance to the railway shop as the arsenal is to the army. Without the arsenal the army would be practically helpless, and the same may be said of a railway shop without a well regulated tool room equipped with the necessary supplies. In order that we may reduce the cost of locomotive repairs and increase the output of the shops, it is necessary to have a complete and up-to-date tool room, wherein we can keep our tools to a standard and be able to manufacture all special tools required, such as are not furnished by manufacturers. A large amount can be saved by having all tools manufactured at one central point. Better supervision as to the need for tools and use of them can be had than is the case when they are manufactured at every point on the system. By concentrating the manufacture of all small tools at a central point a large amount of material which is usually carried at local shops for the manufacture of tools is eliminated, and charges for this material are correspondingly reduced. Machinery which is necessary for the manufacture of these tools in outside shops will be released from that work and may be used for other purposes or be transferred to points where it can be advantageously used.

A careful study should be made of the local requirements, and in place of allowing the different shop or tool room foremen to manufacture tools according to their own notions and ideas, they should be made at the central shop, according to carefully selected standards, and in an efficient and economical manner, after the best modern methods and practices. A large saving in the cost of small tools can be effected by standardization. The manufacture of special tools, devices and jigs, by shop or tool room foremen at the local shops should be discontinued and whenever any employee designs a special device or tool which he and the local master mechanic think to be advantageous or to possess merit, it should be submitted to the central plant where, if its manufacture is found warranted, it can be made standard for the system and be manufactured at the central plant. By the concentration of the manufacture of shop tools at a central point, which possesses facilities for doing this work, the tool room forces at the outside or local shops can be reduced fully one-half.

This plan has been practiced on the Santa Fe for the past five years and has resulted in a substantial reduction in the cost of tools. Each shop and roundhouse is furnished with a stock book in which they enter all the tools on hand, and also what they consider will be required for the coming month. This book is sent to my office with requisitions covering the tools required, and the books are checked against the requisitions. If it is found that the requisitions are proper, they are approved and forwarded to the storekeeper for necessary attention.

No tools are carried in any of the division storehouses, all of them being furnished from the central storehouse. We have standardized all the tools on the system and carry them in large quantities at the central storehouse. All lathe and planer tools of the various sizes are made up and carried in this central stock, and are given symbol numbers for convenience in ordering, which avoids difficulty in specifying sizes required when placing requisitions.

Care of Pneumatic Tools.

J. H. Simons, of the Ingersoll-Rand Company, made the following suggestions as to the care of pneumatic tools: It is doubtful if any piece of machinery pays a greater profit on its investment or cost than a pneumatic hammer or a pneumatic drill kept in good working condition, yet it is equally doubtful if there is any piece of high speed machinery so much abused by neglect to properly clean, oil and renew worn parts, which condition retards the full admission of air to the ports and rapidly cuts down the efficiency and capacity of the tools. In pneumatic tools, as in all other high speed machines, the rapidly moving parts will wear in time—the pistons, ball races, balls, throttle valves, etc., in pneumatic drills, and the throttle levers, bushings, valves, pistons and cylinders in pneumatic hammers; when the wear is sufficient to prevent the full and free admission of air, or allows the escape of air by leakage past a worn part, it reduces the efficiency, and the part, or parts, should be renewed. If this is done, the machines will maintain their efficiency indefinitely.

Operators seem to think that a pneumatic tool should run and develop its full power so long as all the parts are held together, without any regard to cleaning, oiling or tightening up. They should be thoroughly cleaned with kerosene or benzine once every twenty-four hours. A good plan is to thoroughly clean by pouring benzine or kerosene freely into the throttle handle. This dislodges all foreign matter and cuts the thick oil which can be removed by blowing the air through the tool under pressure; then lubricate in like manner with a good quality of light body oil. Sewing machine oil or a winter strained lard oil is good. Heavy oil should never be used on pneumatic hammers or piston type drills, as they cause the tools to work very sluggishly, with consequent loss of power. Heavier oils should be used on the rotary type of drills.

When pneumatic tools are not in use, a good plan is to keep them immersed in kerosene. They should be suspended so that the dirt and foreign matter will settle to the bottom of the vessel, and should then be thoroughly blown out and well lubricated before being put into operation, as kerosene leaves them dry.

We advocate the use of strainers on the tool and filters in the pipe line, arranged so that they can be readily taken apart and cleaned. A good form of pipe line filter is two cast flanged pieces properly tapped and threaded to fit the pipe line, bolted together, with a piece of gauze or fine mesh wire screen between. There are also sundry makes of automatic oilers for pneumatic tools which are placed in the hose line a short distance from the tool and which can be refilled at any time without disconnecting the tool from the hose. They are made in sizes to supply oil for from six to eight hours without refilling.

Another abuse, especially with regard to pneumatic riveting hammers, is a rapidly increasing tendency on the part of operators, particularly where the hammers are used in the construction of steel cars and in structural steel shops, and more especially where "hunky" labor is employed, to use pistons shorter than those adopted by the makers as standard. This is the most flagrant abuse to which a riveting hammer can be subjected and cannot be too strongly condemned. The riveting hammer is designed with parts properly proportioned to meet the requirements of the various classes of work to which it is adapted. Workmen have discovered that a shorter piston than the one furnished with the hammer increases the number of blows per minute and for a time facilitates their work. They usually make these pistons by grinding down a broken standard piston, thus removing the hardening in a large degree and leaving the striking part softer than it should be. These short pistons have a tendency to crumble and the broken parts cut the inner casing of the cylinder; if it is not damaged beyond repair from this cause, it is only a question of a short time when the cylinder will crack or the handle break. When cracked cylinders, broken handles and broken rivet sets are found the hammer should be carefully examined to ascertain whether or not the workman has substituted a short piston. This check can only be made when the hammer is in service as it has been found that the workmen carry the short pistons with them and make the exchange after taking the hammer out of the tool room, replacing the proper piston when returning the hammer at the close of the day.

A large industrial organization, operating some eight or ten plants, inaugurated a system about a year ago for keeping a thorough inspection and record of pneumatic tools from the day of purchase until they became obsolete or worn out. A record is kept of every item of repair made to a tool and a

report filed showing why the repairs were made necessary, that is, whether from abuse, lack of care, bad hose, natural wear and tear, or accident. The mechanical engineer in charge of this recently informed me that in looking over the report for the first six months he was greatly surprised to find that about 30 per cent. of the repairs could be directly attributed to neglect in cleaning and oiling and about 15 per cent. to the use of inferior hose.

Pneumatic tools should have between 90 and 100 lbs. of air to get the best results. The Canadian Government will not accept steam-tight rivets driven with pneumatic hammers unless they are operated by 110 lbs. air pressure.

In conclusion, allow me to offer a few suggestions applying to all makes of pneumatic tools, which, if followed, will insure more and better work from your equipment and will obviate delays and annoyances and minimize the expense of maintenance.

See that the tools are well cleaned and oiled before putting them in operation.

See that the pipe lines are thoroughly blown out before connecting the tool.

Use the best quality of air hose. It is cheaper and more satisfactory in the long run.

See that the pipe lines are provided with filters or that strainers are used with the tools, preferably both.

With drills, adjust the ball-bearings where they are provided so as to take up the lost motion, and be sure that they are firmly held by the lock nuts to prevent working loose or tightening up and binding when in use.

Be sure that the handle of pneumatic hammers is always on tight as the tools may be seriously injured by allowing it to work loose. This controls the joint between the handle and valve box and is of great importance.

See that the operators hold their riveting and chipping hammers firmly against the work. If the die or chisel is allowed to play in and out of the hammer while in operation, it will seriously damage the tool. Every blow should be delivered on the die or chisel and not on the forward end of the bridge of the cylinder in chipping hammers. With riveting hammers which have no bridge in the cylinder it often means the loss of the die and piston by being shot out of the tool.

See that the chisel and rivet sets fit properly in the nozzles and are of proper length, otherwise there is an opportunity for loss of power and injury to the tool.

Discussion.

E. J. McKernan (Santa Fe):—In our main shop they have a kind of a sub-tool room where all the air hammers, hose and various boiler maker's tools are kept, because the boiler shop is in an off-set of the main erecting shop, and we do not want the men to cover any more ground than necessary to get the tools and return them. The man in charge of this tool room is a boiler maker's handy man. He has a vat that is filled with coal oil, which is emptied in the evening on account of the insurance, and he soaks all the hammers in it. Before each motor or hammer is turned out it is thoroughly oiled, regardless of how many times a day. No. 1 is given out and Jones has it an hour or two, it gets oiled again. A man goes around and oils up the tools which are not turned in during the day. It has prolonged the life of hammers two to one.

Tool Room Progress.

M. H. Bray, of the N. Y., N. H. & H., in speaking on tool room progress, said in part: The installation of pneumatic tools made it necessary for the tool foreman to put on his thinking cap and work out new tools for use with these machines. All boiler work, such as cutting out and expanding flues, breaking staybolts to replace fireboxes and cutting off rivets, had been done by hand, but with the use of pneumatic drilling machines and hammers, it is now possible to cut out a set of 308 flues in sixty-five minutes, and expand them in five hours, where in times past it was necessary to take from four to five times as long.

At about the time that pneumatic tools were installed, the first forged tools of high speed steel were tried out, chiefly of the large sizes used for turning steel tires. The results from this steel were so much better than from that formerly used that the smaller sizes for lathe and planer use were installed; with the use of this steel most shops put in a universal tool grinding machine, for grinding all tools used for turning, planing and slotting. It is customary now to have the operator of the machine keep on hand a sufficient supply of these tools ground to a standard shape, that experience has taught was best for the class of work it was to be used on. The use of this machine has done away with the custom of each man going to blacksmith to have a tool forged and grinding it himself. Now he has only to return broken or worn out tools to the delivery window of the tool room and receive a new tool correctly ground and hardened. At present the tool checking system is the hardest proposition to keep straightened out.

The tool room now has modern machinery, such as universal milling machines, lathes, shapers and grinders. The majority of the drills and reamers are made of high speed steel, as are the milling cutters and forged tools. Practically all small repair work on machines throughout the shop is done in the tool room, most of the special tools for use with compressed air are made there, and in many of the shops all taps, reamers, dies of different kinds and drills are made and compare very favorably with the purchased article.

The equipment of the future tool room should be of the best, and the room should be located in a well lighted part of the shop. The disbursing of tools must be done in a quick, orderly manner; all arguments in regard to tools should be decided by the tool foreman. The tool foreman should see that all tools such as reamers, drills, etc., are not abused, and in fact should have complete charge or oversight of the tools under all conditions. The tool checking system must be reorganized, so that it will be impossible for any workman to receive a tool without a check or receive his check for a lost tool.

Other Papers.—An extensive and practical paper on the making of spur, bevel and worm gears was presented by H. E. Blackburn. A paper on special tools was prepared by F. W. Lugger of the Big Four.

Demonstrations.—W. V. Young, of the Hoskins Manufacturing Company, Chicago, had been asked to prepare a paper on the heat treatment of steel. As his office was only a few blocks from the hotel the meeting adjourned to it, and a practical demonstration of the electric furnaces and the use of the pyrometer was given. Mr. Young mentioned the experiments performed by C. P. Berg, which were described in a paper before the Western Society of Engineers (see *Railway Age Gazette*, July 1, 1910, page 31).

A trip was made to the demonstrating plant of the Firth-Sterling Steel Company to study the treatment of Blue Chip high speed steel. On the last afternoon of the convention several of the members visited the plant of the Independent Pneumatic Tool Company at Aurora, Ill.

Election of Officers.—The following officers were elected for the ensuing year: President, M. H. Bray, tool room foreman, New York, New Haven & Hartford, New Haven, Conn.; first vice-president, E. J. McKernan, tool supervisor, Atchison, Topeka & Santa Fe, Topeka, Kan.; second vice-president, John Fuhrman, tool room foreman, Great Northern, St. Paul, Minn.; third vice-president, G. Gestoettner, tool room foreman, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.; secretary-treasurer, O. T. Harroun, tool room foreman, Chicago & Alton, Bloomington, Ill.; chairman executive committee, J. W. Pike, Rock Island Lines, Silvis, Ill. The next annual meeting will be held in Chicago.

Supplymen's Association.—The supplymen's association was composed of the following companies, most of which had exhibits in the writing room of the hotel: American Specialty

Company, Carborundum Company, Chicago Pneumatic Tool Co., Crucible Steel Company of America, Faessler Manufacturing Co., Firth-Sterling Steel Co., Independent Pneumatic Tool Co., Ingersoll Rand Tool Co., Joseph T. Ryerson & Son, Niles Bement Pond Co., Scully Steel & Iron Co., Standard Railway Equipment Co. and The Midvale Steel Co. The officers were: W. H. Dangel, president; H. L. Mills, secretary; E. C. Cook, treasurer.

FLANGELESS SHOES AND WEDGES AND REMOVABLE SIDE MOTION PLATES ON DRIVING BOXES.

In a paper on "Locomotive Frame and Driving Box Construction," presented at the recent convention of the Master Mechanics' Association (see *Daily Railway Age Gazette,* June 22, 1910, page 1747), H. T. Bentley, assistant superintendent of motive power of the Chicago & North Western, said: "Flangeless shoes and wedges should be used to overcome the trouble experienced with flanges breaking. To facilitate the lining down of wedges, arrangements should be made so that they can be removed without disturbing the binders or underhung springs; the wedge bolts should be of sufficient strength and so arranged that in case of breakage it will be an easy matter to replace them."

Flangeless shoes and wedges were first applied on the Chicago & North Western in May, 1907, and have proved so successful that they are now being placed on all new Atlantic and Pacific type and consolidation locomotives used by that company. They were designed and patented by Charles Markel, shop foreman at Clinton, Iowa, and are especially valuable in connection with the Markel removable driving box bearings, which were illustrated and described on page 1365 of the June

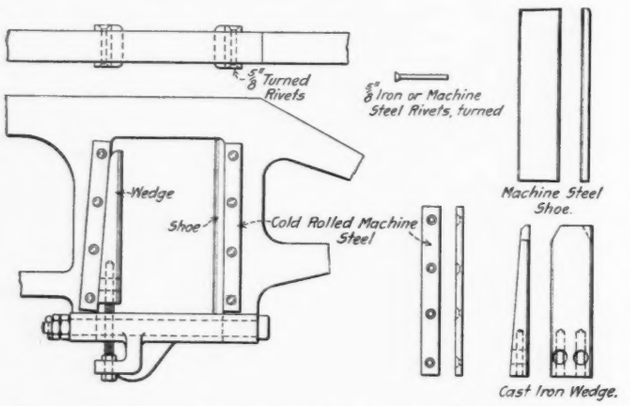


Fig. 1—Details and Application of Markel Flangeless Shoes and Wedges.

3 issue of the *Railway Age Gazette.* The details and the application of the Markel flangeless shoes and wedges are illustrated in Fig. 1. The side plates are of cold rolled machine steel and are riveted to the frame jaws by ⅝-in. hot rivets. The only work required on these plates is to cut them to the proper length, drill the holes and rivet them to the jaws. When they become sufficiently worn to require renewal, duplicate plates may easily be applied. The wedges are flat pieces of cast iron and may be machined at one-eighth the cost of the flanged wedge. The shoes are machined steel and only require machining on one side.

The principal advantages of the device are as follows:

No flanges on shoes or wedges to crack or break. Wedges may be readily adjusted, as there are no flanges to stick to the sides of the frame jaws. Shoes can be made from bar machine steel and will only require cutting off to length. Wedges can be machined for one-eighth the labor cost for the standard wedges. This arrangement provides 1½ in. more bearing to the shoes and wedges on the jaw faces, which is quite an advantage.

A standard wedge for an Atlantic type locomotive costs $3.07 and the flangeless wedge costs $1; the standard shoe costs $2.34, while the flangeless shoe costs $1.50. This makes a saving of $3.91 on one shoe and wedge, or $15.64 on the shoes and wedges for an engine with four drivers. As there are no flanges to crack and break the shoes and wedges will last for years by applying liners to take up the wear on the boxes. The cold rolled steel plates that are riveted to the frame jaws cost for labor and material on an Atlantic type locomotive $4.75. It takes five hours to line down one standard flanged wedge at a labor cost of $2.80. Only one hour is required to line down the flangeless wedge at a labor cost of 56 cents, or a saving of $2.24 in lining down one wedge. This saving is due to the fact that it is only necessary to remove the wedge bolts, and to take out the wedge; it is not necessary to take down the binder, binder bolts or other parts of engine.

A jig for drilling the side plates is shown in Fig. 2. It is

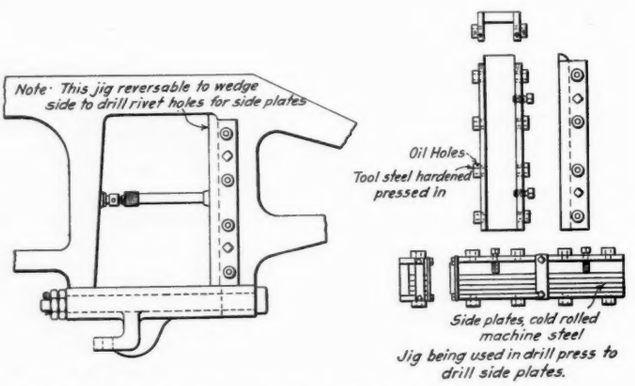

Note: This jig reversable to wedge side to drill rivet holes for side plates
Oil Holes
Tool steel hardened pressed in
Side plates, cold rolled machine steel
Jig being used in drill press to drill side plates.

Fig. 2—Jig for Drilling Side Plates and Frame Jaws.

made from one of the standard shoes, it being only necessary to drill holes in the flanges and fit them with hardened steel bushings. Four side plates can be placed in the jig and drilled at one time; the same jig can be used on the frame jaws for drilling the rivet holes. The drawing shows applications of the jig for both purposes.

The arrangement by which the wedge may be removed by simply removing the wedge bolt and without taking down the binder, or disturbing any other part of the locomotive, is illustrated in Fig. 3. Part of the flange of the driving box is re-

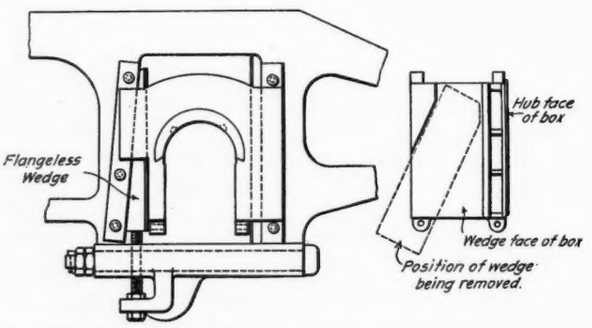


Fig. 3—Driving Box Used with Flangeless Shoes and Wedges.

moved on the inside on the wedge side. As there is no wear on the inside flanges of the driving box the partial removal of the flange does not effect its efficiency. It also leaves a free opening so that the wedge can easily be inspected to see if it is properly adjusted. The eccentrics on the main axle do not interfere with the removal of the wedge. The flangeless wedge

may be lined down in one-fifth the time required for the standard wedge.

REMOVABLE SIDE MOTION PLATES FOR DRIVING BOXES.

The removable side motion plates for driving boxes, designed and patented by Mr. Markel, are shown in Fig. 4. Plates of this kind have been in use on the driving and truck boxes of an

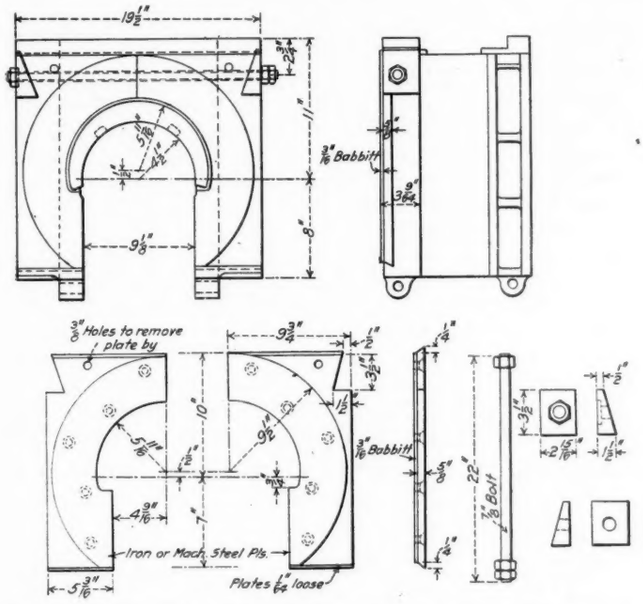


Fig. 4—Removable Side Motion Plates for Driving Boxes.

Atlantic type locomotive since December 1, 1908, with splendid results. Since that time the plates have been renewed on the left main box twice at an average cost of $1.12 for labor and $1.20 for babbitt, or a total of $2.32. Two hours were required for doing the work. The plates may be removed and applied without disturbing any other part of the locomotive; it is only

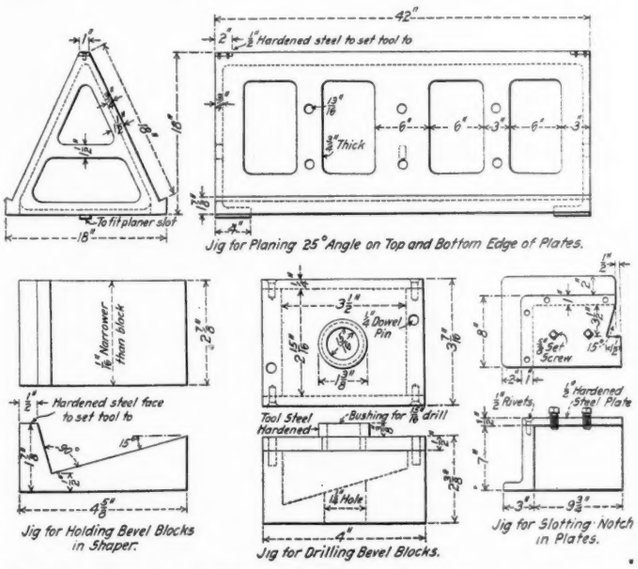

Hardened steel to set tool to
To fit planer slot
Jig for Planing 25° Angle on Top and Bottom Edge of Plates.
Narrower than block
Hardened steel face to set tool to
Jig for Holding Bevel Blocks in Shaper.
Dowel Pin
Tool Steel Hardened
Bushing for drill
Hole
Jig for Drilling Bevel Blocks.
Set Screw
Rivets
Hardened Steel Plate
Jig for Slotting Notch in Plates.

Fig. 5—Jigs for Finishing Removable Side Motion Plates and Bevel Blocks.

necessary to remove the nuts on the stud bolt with a socket wrench, after which the plates may be removed by hand by sliding in the dovetail groove from the center outward. After the plates are rebabbitted and faced to the proper thickness they are reapplied in the same manner. The tapered washers at each side of the plates force both plates tightly against the dovetail groove at the top of the box and hold them rigidly in place. The plates are made of cast steel and are finished all over except the circle for the brass and cellar fit.

The bevel at the top and the bottom of the plates is machined and the plates are made interchangeable by the use of the jig illustrated in Fig. 5. By its use the plates for six driving boxes may be finished at the same time. Babbitt, one-quarter of an inch thick, is then sweat on the hub faces of the plates, after which they are faced to the proper thickness. The dovetail is planed on the driving boxes to fit a gage, making the boxes interchangeable. The motion plates fit loosely so that they may be applied by hand. The driving box is cored to take the bolt which holds the plates in place. The bevel blocks or washers are of cast steel and are machined and drilled on jigs shown in Fig. 5. The bevel block at the left, Fig. 4, has a cavity ¼ in. deep into which the hexagon head of the bolt fits to prevent it from turning while the nuts are being tightened and loosened. The cost of applying these plates to one box is as follows:

	Material.	Labor.	Total.
Two cast-steel plates	$0.66	$0.20	$0.86
One bolt	.10	.05	.15
Two washers	.20	.10	.30
Planing box	...	1.14	1.14
Total cost			$2.45

As stated before, it costs $2.32 to take up the side motion in one box equipped with this device. With the standard equipment it costs five or six times as much, including the cost of dropping the drivers, and keeps the engine out of service about 15 hours as compared to 2 hours with the removable plates. Excessive side motion will not be allowed on engines equipped with the removable plates, because of the ease with which it may be remedied, and breakages of other parts of the locomotive due to this cause will thus be obviated.

HOW THE FOREMAN CAN PROMOTE SHOP EFFICIENCY.

BY W. H. SNYDER,

Assistant General Foreman, New York, Susquehanna & Western, Stroudsburg, Pa.

The first step in improving shop efficiency is to have a proper organization. A good system of management has been defined as a means of causing men to co-operate for the cause of both employer and employee. In shops where foremen do not co-operate with each other the shop efficiency will be sure to suffer.

Staff Meetings.—At our shops the master mechanic and general foreman have established staff meetings; at a stated time the foremen are all called together and the question of shop efficiency is thrashed out from tip to toe; also the question of economy as to the saving of material, the proper methods of doing and handling work, the necessity of close inspection of work, etc. These staff meetings bring out a great many good points and add greatly to the shop efficiency.

Employment.—After the supervision is properly organized the next important question is the kind of men to employ. The various industries must compete for the best men and boys or else take the ones that are left over; any shop wanting to hold a high standard in efficiency must have skilled mechanics and good boys. They must not only be well trained, but well treated, or they will naturally drift into a more congenial shop—if one is to be found. It is human nature to secure the most comfort and the best treatment possible. What we need are men that are interested in the shops' success; conditions are changed as to shop methods, but the value of real interest means a great deal in shop efficiency, and when you have men who say "we" and talk about "our shop," it means more than one can realize.

The Apprentice.—A careful study and selection must be made when hiring apprentices. Many shops are earnestly and honestly trying to get apprentice boys that are active and show an interest in learning a trade, and they train them to be a credit to the trade and shop. The question is where to get the boys that will take the interest in their work and their employer, and work faithfully to do their best to learn and make a good showing in

both quality and quantity of output. Every shop takes pride in making good workmen as well as good mechanics, and there is no trouble with boys of this kind when you can get them.

The apprentice boy that will come to work at seven o'clock in the morning and at eight o'clock is at his dinner pail lunching, watching his boss, and waiting and looking for quitting time an hour or so before the time for the whistle to blow may just as well step down and out and give some one else a chance, for he is only a detriment to the shop efficiency.

The active apprentice is always noticed and watched by his foreman, and when the opportunity comes for advancement the best one is chosen. It is true that we cannot all have good positions, such as master mechanic, superintendent, general foreman, etc., but it is also true that there are times when a foreman is to be appointed and the man that has shown the most interest and has been the most active during his apprenticeship gets the preference.

Machinery and Tools.—The output of any shop is largely dependent on the machine shop, so it is important that the installation of machines be thoroughly investigated, and that the most powerful machinery be installed. In a shop where the machinery is already located the work will have to be carefully sorted out and the machine that is the best adapted for certain work should be assigned to do it. The heavy work must be taken to the heavier machines and the lighter work to the lighter ones, etc. Shop efficiency depends largely on the management of the machine department, and very often by the use of a special device excellent results have been obtained from the oldest machine in the shop.

Quality of Tool Steel.—After the machines have been properly arranged and equipped with the best facilities and shop kinks that can possibly be obtained, the question of tool steel comes up. There is nothing that will keep down machine output more than a poor grade of steel. In the purchasing of tool steel for machines such as lathes, planers, slotters, etc., the best grades should be used in order to keep the machines up to their maximum capacity. If you will stop and consider the time that is lost in a shop trying to use a poor grade of steel and the time that is required for a tool dresser to dress and keep it up, and the amount of steel that is wasted each time that a tool has to be dressed, you will find that a poor steel is the most expensive in the long run. After a tool is dressed it has to be taken to the tool room for grinding; a great many shops do not have the facilities for grinding in the tool room and the machine hand has to grind his own tools. The more trouble he has in keeping up his tools the more it will interfere with his efficiency. It is also important to use a good grade of steel for hand chisels, flue beading tools, boiler punches, rivet sets, etc., as these tools are expensive in their construction, especially the flue beading tools and rivet sets, and it does not pay to have high-priced tool-room men spend their time making tools of a poor grade of steel.

Special Devices.—The installation of special devices is becoming an important factor in shop efficiency, and the *Railway Age Gazette* deserves great credit for the competitions it has conducted so successfully the last few months. The special devices and kinks that are brought out by the competitions are of great value to any shop foreman. They give him, without any effort on his part, the benefit of years of experience and labor of mechanics from all over the United States, and I am sure that eventually a great many of these devices will be used generally, and by their use will add much to shop efficiency.

The use of fuel oil has greatly reduced shop costs in many ways. The use and introduction of oil furnaces has saved much labor in the handling of work from one shop to another, as heretofore flues, water bars, etc., had to be carted to a certain place where a forge was located, in order to have them annealed or swedged. In removing and applying locomotive driving wheel tires by the use of fuel oil the cost has been reduced about half at this shop. Also by the use of the same burner the cost of welding locomotive frames has been reduced to about one-half. Instead of taking the frames down and carting them to the blacksmith shop to be welded, the frame is prepared and heated with a burner using crude oil. This saves the cost of removing the frames. The same burner is also used for straightening frames when locomotives come in with their front frames bent.

OXY-ACETYLENE WELDING AND CUTTING.

BY WILLIAM G. REYER AND R. W. CLARK,

General Foreman and Boiler Shop Foreman of the Nashville, Chattanooga & St. Louis, at Nashville, Tenn.

Side sheets can be successfully welded in a locomotive firebox in a comparatively short time and with very little trouble if the work is properly done. Provision must be made for contraction when the weld cools off. The cutting of the opening for the patch in the firebox should be done with a pneumatic hammer and not with the blowpipe, as in the latter case the steel will oxidize where it is cut and it will be difficult to make a successful weld. The sheet and the patch should be trimmed with a bevel such that when the patch is set up ready for welding the two sharp pointed edges will touch and an opening or V will appear leaving an angle of 45 deg. between the two edges of the sheets (Fig. 1). To allow for contraction

Fig. 1—Partial View of Patch About to Be Welded to the Side Sheet.

of the patch a U should be formed near its edge, as shown in Figs. 1 and 2, and projecting on the same side as the open side of the V formed between the edges of the two sheets. This can be made on a press, or under clamps or with a fuller. On a $\frac{5}{16}$-in. sheet, for instance, the U depression should be about ½ in. deep with a radius of about ½ in. While the weld is cooling off the U should be hammered down with a pneumatic hammer. The U must, of course, project toward the fire side so that it may be hammered. In putting on a patch it is best to apply the staybolts before welding. Splendid results have

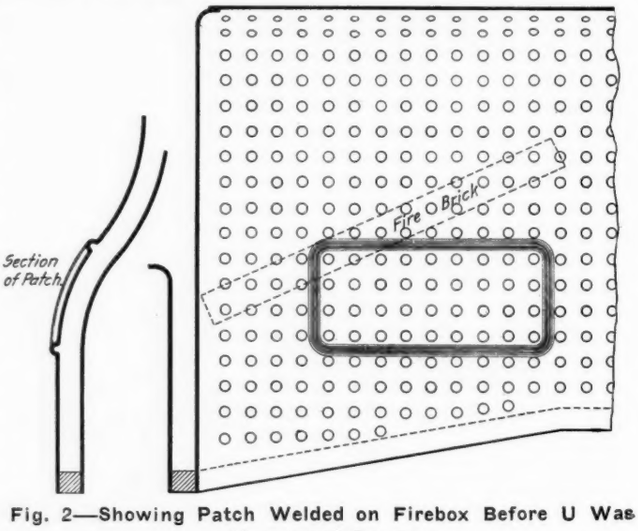


Fig. 2—Showing Patch Welded on Firebox Before U Was Hammered Down.

been obtained in making a large number of welds in this way, some of them directly under the arch on high pressure boilers.

The welding torch should be kept clean. If two much oxygen is used the metal will oxidize and will not weld. To get a perfect weld in applying a half side sheet form a U along the top of the sheet. In welding a fire door flange where the sheet is cracked in the knuckle of the flange, do not cut out any more of the door sheet than is necessary, keeping the weld as near the turn of the flange as possible, thus leaving it free to contract without putting much stress on the weld. If this can-

not be done it will be necessary to use a U, as described above. It is good practice to hammer on the heel of the flange after welding.

Cracks develop in the firebox that can be welded perfectly and, again, there are cracks that cannot be welded satisfactorily. For instance, if a crack in the knuckle of the flange runs the long way of the flange, it can be cut with a diamond point chisel and a good weld can be made. If the crack is around the knuckle of the flange it is useless to try to weld it, as there is no way to provide for contraction, and nine times out of ten

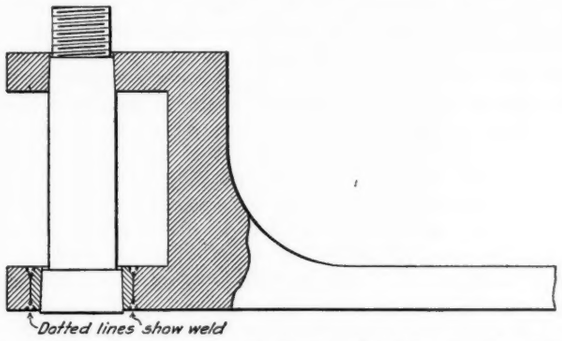
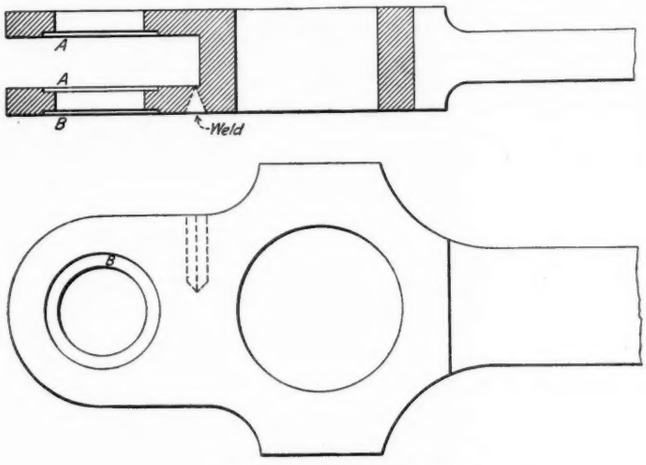


Fig. 3—End of Eccentric Blade Repaired by Oxy-Acetylene Welding.

the weld will pull apart. Where the crack is in the center of a side sheet, we have never been able to make a successful weld; the first effort to weld a crack in a side sheet caused no end of trouble; the crack extended 12 in. from one staybolt to another, taking in three staybolts. It was cut out with a diamond point tool and apparently welded very satisfactorily, but after the weld cooled off it was found that the next row of staybolts had developed a similar crack—the contraction had pulled the sheet apart in the weakest place. The new crack was cut out and welded and after cooling a similar crack developed which opened $\frac{3}{32}$ in. We continued to weld one crack after another until the first weld made had broken. We tried to



Broken Jaw Welded and Reclaimed.

Fig. 4—Damaged Jaws on Rods Which May Be Repaired by Oxy-Acetylene Welding.

weld it again but found it impossible to make a successful weld because of oxidization. We cut out the bad place in the sheet and applied a patch, which proved entirely satisfactory.

This process is not only convenient and reliable, but is economical for welding links, link lifters, link blades, intermediate ends on side rods, crossheads, driving boxes, reverse levers, quadrants, guide yokes, driving wheels, driving wheel tire flanges, Leeds coupler, channels on tank truck frames, lubricators, frame braces. For cutting purposes it cannot be excelled. When engines come into the roundhouse with badly cut eccentric blades at the pin hole, it is the practice to ream the hole out, countersinking it on both sides and to place a bushing in position, as shown in Fig. 3, and weld with the oxy-acetylene torch. The Vs indicated by the dotted lines are 45 deg. and about ¼ in. deep. The hole is then reamed to standard size. Before we installed the oxy-acetylene plant it was necessary to apply a new end to the eccentric blade, which, under the best conditions, would consume eight to ten hours, whereas this work is now done in one hour.

We experienced trouble with our knuckle bushings and washers wearing into the rods, thereby weakening them. We now weld these worn places, restoring them to original thickness. The jaws, in one case, were worn at A and B (Fig. 4) and cracked at the point indicated by the arrow. Rods scored,

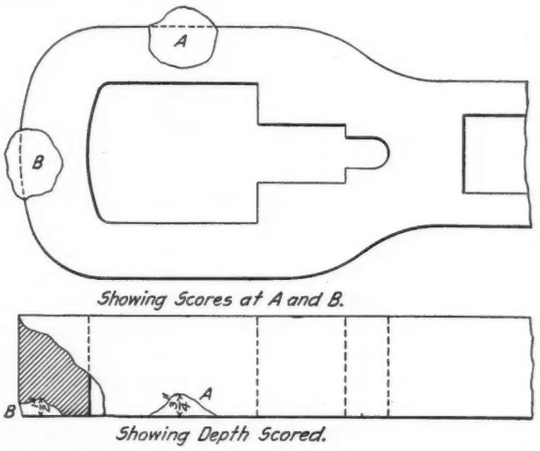


Fig. 5—Scored Connecting Rod Repaired by Oxy-Acetylene Welding.

as shown in Fig. 5, are also easily repaired by welding on material.

The top of the flanges were cut on the tires of a derailed engine, as shown in Fig. 6. Under former practice it would necessitate reducing the tire ¾ in. in diameter. With the oxy-acetylene process the tire, which was practically new, was repaired and put in first class condition at a cost of $1. To have turned the tire, reducing it ¾ in. in diameter, would have cost $7.06, and in addition we would have lost ⅜ in. of tire wear. We reclaim any number of quadrants and latches by building up the worn teeth, thus effecting a large saving. On steel driv-

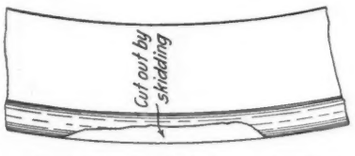


Fig. 6—Steel Tire Cut by Skidding and Reclaimed by Oxy-Acetylene Welding.

ing boxes where the cellar bolt wears the hole oblong we drill a larger size hole and countersink it. A plug is driven in and welded. The hole is then drilled to the original size. We build up reverse levers to proper size when they become worn from the latch. Where we find guide yokes cracked we chip out the crack and weld it with oxy-acetylene, thereby economizing in both labor and material. Front end couplers on locomotives crack in different places and are condemned by the inspectors. We weld these cracks successfully. We have likewise reclaimed a number of fractured channel beams. We have also welded tool holders, staybolt taps, shafts, carpenter chisels, bits, hammers, adz, and iron pipe, including branch pipes, dry pipes and air pipes of all sizes.

A piece of shafting 122 in. long and 4½ in. in diameter, used in connection with the hoisting engine of a yard crane was badly

worn, as indicated in Fig. 7. A new shaft would have cost $25. The shaft was turned down at the worn part and a sleeve was made with the inside diameter corresponding to the diameter of the part turned down and the outside diameter to the full diameter of the shaft. The sleeve was cut to proper length to

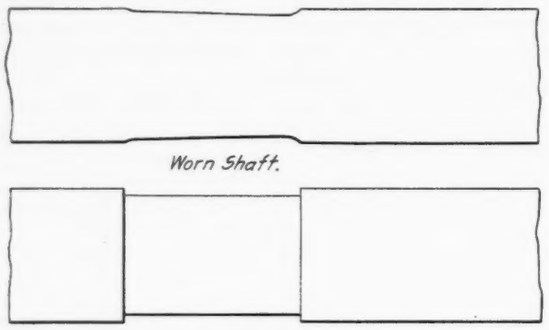


Fig. 7—Worn Shaft Which Was Repaired by Oxy-Acetylene Welding.

fit between the shoulders and then split in two halves and welded on the shaft. A little filing finished the job. The cost of repairs did not exceed $1.50. The success of the work lies in the skill of the operator, and this can only be acquired by practice and careful study.

OPERATION AND ORGANIZATION OF THE EAST ALTOONA ENGINE HOUSE, PENNSYLVANIA RAILROAD.*

BY WILLIAM FORSYTH,
Associate Editor, *Railway Age Gazette.*

The most interesting example of American engine house practice is that in the classification yards of the Pennsylvania at East Altoona, Pa. Here the traffic from three divisions of the road is concentrated, classified and despatched. The freight tonnage passing through this terminal is claimed to be the largest handled by any single system of freight yards in the world. The total capacity of the yards is 10,500 cars. During the month of November, 1909, the engine movement at this engine house was as follows:

Average number of locomotives despatched east and west in 24 hrs.....243
Maximum number despatched in 24 hrs.....290
Maximum number despatched in 1 hr. including switch engines..... 40

The trains are operated by consolidation locomotives, and on account of the grades on the eastern slope of the Allegheny mountains westbound trains require three locomotives, two in front and one as a pusher. Eastbound, the line follows a comparatively light gradient along the Juniata river, and here large trains can be handled by one consolidation locomotive. There are 35 switch engines, requiring 70 engine crews for day and night operation. During the month of November, 1905, there were handled over the ashpit a total of 6,497 engines. The number of men employed in the yards during the month averaged 1,012, and the number of men employed about the engine house, shops and coal wharf and on the motive power roll was 700. Near the center of the length of the terminal is located a large engine house, with ashpits, coal wharf, sand supply, a good-sized machine shop, storehouse and office with bunk rooms overhead; also a power house, a fan house for heating, an oil house, and toilet and locker house.

THE ENGINE HOUSE.

The engine house is in diameter and cross-section the largest structure ever erected for this purpose. It has an exterior diameter of 395 ft. and a 100-ft. turntable. There are 52 stalls 90 ft. deep. The main portion of the house is 65 ft. wide and 30 ft. high. On the outer circle there is a lean-to 25 ft. wide and 18 ft. high. The engines head in toward this lean-to and the smokejack is located alongside the main columns at the outer portion of the main building. The main portion of the house was made 30 ft. high to accommodate a traveling crane, but columns for supporting the crane have not been erected, as jib cranes secured to the main columns were found more desirable. There are four drop tables, operated by electric motors, two of them for driving wheels, one large table for all wheels except the engine trucks, and another for pony truck wheels.

The coal wharf is a large structure arranged with a trestle approach having a grade of 3.88 per cent. The coal is dropped from hopper cars directly into bins, and no cover is provided for the cars, as they are emptied entirely by gravity, and no men are employed in the unloading. A special gate and hood are used for regulating the flow of coal from the pockets to the tender. A steel gate drops below the floor of the pocket, and is operated by a compressed air cylinder. At one end of the coal wharf is a sand house, where sand is dried in large stoves and descends through a grating to a reservoir, from which it is elevated by compressed air to the sand bins overhead, and flows by gravity to the engines.

Near the approach to the coal wharf are four ashpits, each 240 ft. long, two on each side of the wharf incline. Each pair is operated by an overhead 5-ton electric crane which spans four tracks, two of them over the ashpits for ash cars. Ashes are dumped from the engines into steel buckets which run on wheels on a track in the ashpit. These buckets are elevated by the crane and transferred to the ash car, where they are dumped. Beyond the ashpits at the extreme end of the coal wharf are inspection pits, 80 ft. long and 3 ft. deep, and connected by an underground passage extending under the coal wharf track.

The work performed in an engine house includes almost everything in connection with locomotive repairs that does not require the locomotive to be sent to the general repair shop. No attempt will be made to itemize these repairs. The work which must invariably be performed periodically consists of boiler testing every six months; boiler washing, from once a week to once a month, as necessity arises; staybolt testing each week; examination of smoke-box, draft arrangements and ash pans each week; testing steam and air gages each month; washing tenders each month; gaging height of pilots each week; gaging tank water scoops each trip; testing air brakes each week; draining main reservoirs each week.

Reporting and Performing Daily Work.—When a locomotive arrives the first information the organization receives as to work necessary is in the engineer's report, which he delivers at the inspection pit when the locomotive is turned over to the inspectors. Five inspectors are here employed, as the work must be done thoroughly in a minimum amount of time, so that the hostler can move the locomotive to the ashpit and make room on the inspection pit for other locomotives waiting. One inspector examines the underpart of the locomotive and tender; one on each side inspects the outside parts, such as driving wheels, rods, steam chests, guides, crossheads and Walschaert valve gear; there are two air-brake inspectors, one to operate the brake valve and inspect the fittings in the cab and the air pump, and the other to inspect all other parts of the air and sanding equipment.

All defects found by the inspectors are entered upon regular blanks and transmitted, together with the engineer's report, to the gang leader in charge at the inspection pit, who decides whether it is necessary to send the engine to the house or whether the repairs are so slight that they can be made on the outside repair pits in connection with the outbound storage tracks. His decision is marked upon the report, and upon the steam chest of the locomotive, and the reports are forwarded to the work distributor's office by pneumatic tube in 45 seconds. This saving in time over the 10 minutes ordinarily required by messenger is a decided advantage to the work distributor, as he

*From a paper on "American Locomotive Terminals," presented at the joint meeting of the American Society of Mechanical Engineers and the Institution of Mechanical Engineers, Birmingham, England, and London, July 25 to 30, 1910.

is able to assign the work to various gang leaders, and have the necessary material ordered before the locomotive arrives in the house or on the repair track.

While the inspectors are at work the lamps and torches are filled and trimmed by two lamp fillers. There is no further necessity for the engine house force to open the tool boxes, which are locked by the engineer, and the keys, together with his time card, are delivered to the engine despatcher at the foreman's office. The engineer is then relieved of all responsibility and of the care of the locomotive.

The engine moves from the inspection pit to the ashpit, where the firebox, ash pan and smoke box are cleaned. It then moves to the coal wharf, where the tender is filled with coal, and a little farther on reaches the sand house, where it receives a supply of sand and water. It then moves into the engine house or to the outbound storage tracks, as necessity requires. If it goes to the engine house the track number and the time of arrival are reported by telephone by the turntable motorman to the work distributor, who by this time has the work which was reported by the inspector and engineer subdivided and assigned to various gangs. After completing the work these gangs report the locomotive ready for service to the engine house office, where arrangement is made for the movement of the locomotive to the storage siding to await assignment to a train. If the locomotive does not go to the engine house it is moved directly from the sand house to the storage siding, and the necessary work is assigned to a gang located on the storage tracks to make light repairs, after which the locomotive is reported ready for service.

Engine Tracing.—At East Altoona there are sometimes as many as 200 locomotives within the engine house jurisdiction, and it was found necessary to inaugurate some efficient method of locating them exactly at all times, so that men sent to make repairs will have no difficulty in finding any particular locomotive required. This is accomplished by telephone. Each time a locomotive moves to another locality the engine tracer in the foreman's office is advised as to where it came from and where it has been delivered, giving the number, the location on the track and the time in each case. When traffic at East Altoona is normal the engine house must deliver ready for service one locomotive every five minutes during the whole 24 hours of the day, as the engines for three divisions are here concentrated. It is vitally important that everything should run in absolute harmony, as any interruption in this rapid flow would quickly result in a congestion on the road.

Engine Despatching.—After the engine tracer has been advised that a locomotive is placed on the storage track for service, he informs the engine despatcher, to whom the crew callers report. The engine despatcher is also in touch with the yardmaster, and is the middle man between the engine house foreman and the yardmaster. As soon as the yardmaster receives information that he needs a locomotive and crew for a certain train of a given class at a certain time, he advises the despatcher, who immediately calls out a crew, and when they arrive assigns to them the locomotive selected, which is standing on the outbound storage track. The houses of the engine men have been equipped with telephones connected with the engine house office, an arrangement which dispenses with messengers and enables the crews to be called promptly.

The fireman usually arrives first, and after receiving his time card and keys takes charge of the locomotive, relieving the engine watcher of any further responsibility, and immediately prepares a fire for road work. The engineer, upon arrival, after receiving his time card at the engine house office and inspecting the bulletin board to read any new orders, goes to the locomotive and oils the machinery, and then waits until he is given the proper signal to move out of the storage yard. The crews are usually called in sufficient time to prepare the locomotive properly for road work prior to leaving the storage track.

Organization of Staff.—For the operation of this locomotive terminal an elaborate organization has been worked out, based upon the principle that none but the heads of sub-departments shall report to or receive instructions from the foreman, his assistant or the work distributor. The responsibility of supplying material and the supervision of the workmen are placed directly upon these gang leaders, who are foremen of their respective gangs. Certain questions of discipline must be handled by the foreman personally, but questions relating to rates of pay, transfers, discipline, etc., ought to originate with the gang leaders, and their duties are not confined to giving out work to the men after the distributor has assigned it. This results in successful operation, and it also gives some dignity to the position of gang leader, and at the same time relieves the foreman of petty details.

The foreman of a large engine house should not be an ordinary shop man, but should have some outlook over and interest in the operating department. He should be a good disciplinarian, commanding the respect of his men, should display clear judgment and form conclusions quickly. He should be a good all-round organizer, and capable of taking care of business promptly during rush hours. He should know how to make brief and intelligent reports and possess mechanical ability. He should be broad-minded enough to recognize that there is a commercial side to transportation, and should not be overburdened with office work. His assistants should possess sufficient ability to decide what work may be slighted or not done at all, and a locomotive still be safe to make one or more round trips.

The engine house foreman receives from the division master mechanic instructions pertaining to such matters as the number of men required, rates of pay, discipline, maintenance of his entire plant, and standards. He receives from the division superintendent instructions relating to crews and despatching of locomotives, and carries out such discipline of the engine crews as may be imposed by the division superintendent through the road foreman of engines. He must co-operate with the road foreman of engines concerning the condition of power and its performance on the road, and the amount of coal and oil consumed. He must carry out orders issued by the road foreman of engines concerning the assignment of locomotives and crews. At East Altoona the engine house operation is a continuous one throughout the day and night, and the night force is practically the same as the day force.

Reporting directly to the engine house foreman are the *assistant day foreman and assistant night foreman.* Reporting to assistant foremen for office work are the *first clerk,* who takes all the foreman's and the assistant foremen's dictation, and the *second clerk,* who has charge of all messengers and ordinary clerks who may be engaged in computing the time and earnings of the men and in getting together all the information required by the master mechanic's shop clerk and for properly keeping the records. Next in order is the *engine despatcher,* to whom report the *engine tracer,* the *callers* and the *clerks* who keep the records of engineers and firemen of locomotives arriving and departing. The engine despatcher marks up the crew board, issues time cards to engine crews going out, and accepts and approves them upon their return.

Next in order reporting to the assistant foreman are the various *gang leaders.* First is the gang leader in charge of the machine shop. The work of his men is confined to machine and vise work, and they are not called upon to leave the machine shop and make repairs in the locomotive shop or storage yard except in cases of emergency. Their work is chiefly preparing and fitting the repair parts which the engine house employees apply to the locomotives. The gang leader in charge of the blacksmith shop has charge of all smiths and helpers, as well as the forces of flue welders and laborers in the engine house engaged in piecing flues and preparing them for locomotive boilers. The gang leader of the power plant has full charge of stationary engineers and firemen, electricians and wiremen. Another gang leader has charge of the ordinary helpers and sweepers in the engine house, who keep the shop property clean.

The foreman in charge of all employees actually handling locomotives, from the time they arrive at the terminal until they

are turned out, also of all workmen engaged in the engine house or storage yard, is called the *work distributor.* Clerks reporting to his two *assistants* receive the engineers' and inspectors' work reports and copy the work required on slips of paper numbered consecutively and properly dated. These slips are then delivered to the gang leaders of the men who perform the work.

The men composing the gangs working on a piece work basis are divided into pools of three or four men, with leaders. The *pool leaders* are under the direction of gang leaders. When the earnings of three or four workmen are pooled it is found that each man is determined that the others should perform their fair share of work, and in case one man fails to do this the remainder insist that the lazy or careless workman be taken out of their pool.

The gang leaders at the inspection pits are in charge of *inspectors, lamp fitters and engine preparers,* who handle the locomotives between the inspection and ashpits.

There are three *assistant gang leaders* in charge of the *engine preparers.* Assistant No. 1 has charge of all work in cleaning fires and placing the locomotives in the engine house or storage yard and of *the ashpit men and crane operators* who load cinders. Assistant No. 2 has charge of the *coal gagers and sand house men, turntable operators* and men engaged in handling locomotives from the engine house to the storage yard. Assistant No. 3 has charge of the men handling locomotives in the storage yard and despatching them when ordered for service, including *engine watchers, switchmen and engine timers.*

Next reporting to the work distributor is the *gang leader of boiler washers,* whose men wash out the tenders, blow out, wash, fill and fire all boilers, and watch locomotives until they are removed from the engine house. Next is the *gang leader of staybolt inspectors,* whose men test staybolts and examine fireboxes and tubes. There is a *gang leader of boiler makers,* engaged in renewing tubes and staybolts, patching, testing and calking tubes, and general boiler work. A *gang leader of engine cleaners* has charge of men cleaning locomotives and tenders. There is a regular schedule for doing this work, and it is so arranged that the work is performed when the locomotives are receiving staybolt repairs or boiler washing. A *gang leader of spongers* is in charge of packing journal boxes and other work relating to lubrication. In the engine house there is a *gang leader of machinists,* who are engaged in setting valves, renewing packing and all other general machinist work on the locomotive proper. The *gang leader of tank repairs* is in charge of repairs to tenders, frames, tanks and couplers, of renewing truck wheels, and other tender repairs. The *gang leader of air-brake repair men* keeps in order the air brakes and sanding equipment. The gang leaders of men on piece work should have not more than ten or twelve men under them, with the exception of the gang on boiler work.

EXPERIMENTAL MALLET ARTICULATED LOCOMOTIVE.*

BY G. I. EVANS,
Chief Draftsman, Canadian Pacific.

A Mallet articulated locomotive was designed and constructed by the Canadian Pacific during 1909, embodying some original features which, in addition to its being the first of its kind on that road, made it, as stated above, an experimental locomotive. The object of this paper is to briefly describe some of the details of its construction and tests made on it, and what it is doing in regular service. As the locomotive was to be used in pushing service in the Rocky mountains, it was necessary that it should traverse curves of at least 15 deg. and have comparatively high tractive power. Following are the general dimensions and data for the locomotive:

Type	0-6-6-0
Gage	4 ft. 8½ in.
Service	Pusher
Fuel	Bituminous coal
Tractive effort	57,400 lbs.
Weight on drivers, working order	262,000 "
Weight, total in working order	262,000 "

*A paper presented before the Canadian Railway Club, Montreal.

Weight of engine and tender, working order	391,000 lbs.
Weight on drivers ÷ tractive effort	4.57
Tractive effort × dia. drivers ÷ equivalent heating surface	975
Equivalent heating surface ÷ grate area	59
Weight on drivers ÷ equivalent heating surface	77
Wheel base, front engine	10 ft. 4 in.
" " rear engine	10 ft. 4 in.
" " total engine	35 ft. 2 in.
" " engine and tender	60 ft. 7 in.
Cylinders, diameter and stroke, high pressure	23¾ in. × 26 in.
Cylinders, diameter and stroke, low pressure	34 in. × 26 in.
Valves, diameter and kind, high pressure	11-in. piston
Valves, diameter and kind, low pressure	12-in. piston
Driving wheels, diameter	58 in.
Driving axles, size	Main, 9½ in. × 12 in.; others, 9 in. × 12 in.
Boiler, kind	Radial stayed, wagon top
Pressure	200 lbs.
Firebox, length and width	120 in. × 69⅞ in.
" thickness of sheets	13/32-in., 5/16-in., ½-in. and 5/16-in.
" water spaces	Sides, 4½ in.; throat, 5 in.; back, 3½ in.
Tubes, number and diam. in front section	281, 2 in. O.D., and 12, 2¼ in. O.D.
" length in front section	96 in.
" number and diameter in rear section	289, 2 in. O.D.
" length in rear section	109 in.
Heating surface, tubes	2,605 sq. ft.
" " firebox	180 "
" " total	2,785 "
Superheating surface	420 "
Equivalent heating surface*	3,415 "
Grate area	58 "
Tender tank, kind	Semi-water bottom
" frame sills	Centre, 13 in.; sides, 10 in.
" trucks, kind	Equalizer
" wheels, size	34 in.
" axles	5½ × 10 in.
Water capacity	5,000 Imp. gals.
Coal	12 tons

*Equals total heating surface + superheating surface × 1.5.

Construction, General.—Reference to the drawings shows that there is considerable difference between this design and other locomotives recently put into service on American railways. The most striking difference is in the arrangement of the cylinders, the shortness of the front bumper or footplate, and the position of the superheater. The absence of front and back guiding trucks is also noticed. This arrangement of cylinders, whereby the two pairs are brought together near the center of the locomotive, permits of an extremely simple pipe arrangement, cutting out a number of packed expansion joints, everyone of which is a continual source of trouble through leakage. The removal of the cylinders from the front also permits of shortening the overall length of the locomotive, and, as locomotives of this type are very long, every foot possible must be saved to permit of their being taken into existing roundhouses. Provision has been made for changing the piston packing rings by simply removing the front cylinder heads, disconnecting the main rod from the crosshead, and pushing the piston out into the space between the two cylinders. The piston valves have also been taken care of in a similar manner, so there can be no objection to this arrangement on account of inaccessibility.

Boiler and Superheater.—The boiler is of the wagon top type, as shown in Fig. 2, is radially stayed, and has an unusually small front ring and smokebox. There are three separate compartments in the barrel, the front of which is practically a feedwater heater, and, owing to its small diameter, is full of water all the time. The injectors discharge into this compartment, which is connected to the boiler proper by two equalizing pipes 4 in. in diameter, one of which is located on the side center line and the other on the top. The second or middle compartment is for the superheater, which consists of double loops of 1¼-in. seamless steel tubing dropped down into the path of the hot gases from the firebox. There are 69 of these superheater elements. One end of each connects to the saturated header, which takes steam from the boiler, and the other connects to and discharges into the superheater header, which is connected direct to the high pressure cylinders. When the locomotive was first turned out the superheater was connected to the low pressure cylinders, but, from tests made subsequently, it was changed as described. The reasons for this are explained further on. Two ¾-in. blower pipes are so located as to blow jets of steam diagonally across the superheater compartment through the tubes to bring down any soot.

There is no steam in the superheater pipes when the throttle is closed, but no cases of burning out have developed after about four months' service, nor is any trouble anticipated, as this condition applies, although to a lesser degree, to other

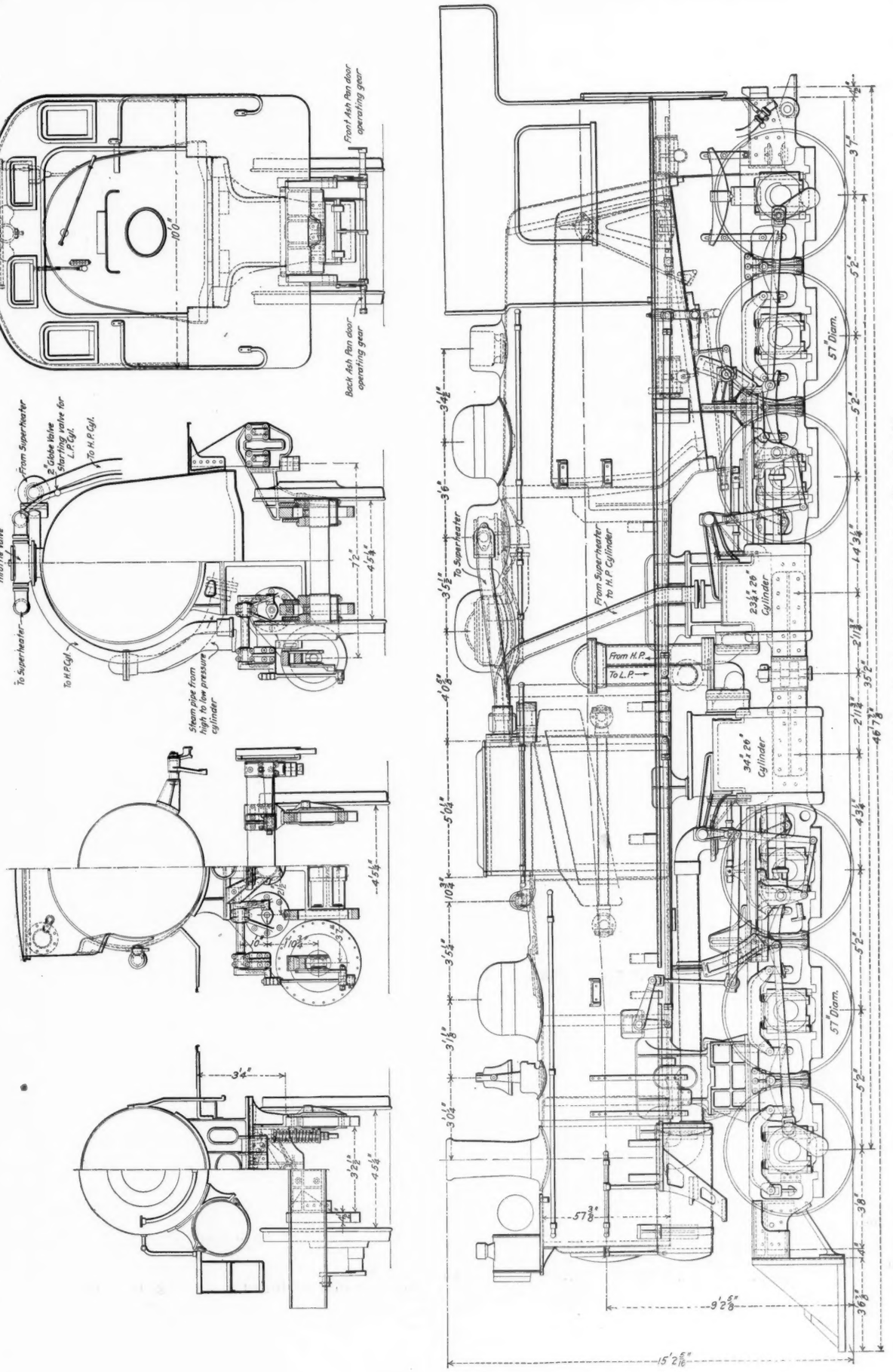


Fig. 1—Experimental Mallet Articulated Locomotive, Canadian Pacific.

types of superheaters which are giving good service. The superheater pipes are secured to the headers by union nuts and are readily removable for repairs, one element at a time, through the opening at the top of the boiler, which is closed by a flanged steel door. If necessary, the complete superheater, header and tubes may be lifted out bodily.

The back compartment is the boiler proper or steam generating section and the construction is similar to ordinary boilers, except that the radii on the corners of the firebox, both inside and outside, are larger than usual to decrease the rigidity of the sheets and reduce staybolt breakage.

There are four flue sheets in the boiler and two sets of flues. The front set is 96 in. long and the back 109 in., with a 63-in. superheater compartment between, and although cleaning holes have been applied underneath, it is seldom found necessary to use them, all cinders being carried through by the action of the draft.

The front section of the boiler is really a feed-water heater, and has 281 tubes 2 in. o.d. and 12 tubes 2¼ in. o.d., giving 1,230 sq. ft. of heating surface, leaving 1,555 sq. ft. in the steam generating section (tubes and firebox). The measure of steaming capacity of this locomotive, as expressed by the formula $\frac{\text{T.P. (max.)}}{\text{H.S. (Total)}} \times$ dia. drivers, is shown in comparison with others of a similar type in the following table, and, as the Canadian Pacific locomotive has a superheater, the equivalent heating surface has been used:

Road.	Builder.	$\frac{\text{T.P. (max.)}}{\text{H.S. (total)}}$ x diam. drivers
Can. Pac.	Can. Pac.	975
B. & O.	A. L. Co.	715
Gt. Nor. (road)	B. L. W.	813
Gt. Nor. (pusher)	B. L. W.	690
Erie	A. L. Co.	910
D. N. W. & P.	A. L. Co.	775
Cen. Brazil	A. L. Co.	915

It might seem that the Canadian Pacific locomotive would not steam satisfactorily. This, however, is not the case, as an inspection of the boiler pressures in Figs. 9 and 10 will show.

The injector check valve is located on the top center line of the boiler, and consists of a cast-iron body, with connections for the right and left hand injectors, and a third connection suitable for a pipe or hose coupling, which is used for filling or blowing off the boiler.

Throttle, Steam and Exhaust Pipes.—The throttle valve is located on the top of the boiler, outside, and consists of an iron casting having two 5-in. steam pipe connections, one on either side. The joint to the boiler is made by a brass ball ring, having an opening 12¾ in. in diameter. The throttle casting extends down through this and connects to a cast-iron dry pipe, which takes steam from a dome set further forward on the same course. The arrangement of this is shown clearly on the boiler drawing, Fig. 2. Outside steam pipes lead from the throttle to the saturated header of the superheater and steam, after passing through it, goes directly to the high-pressure cylinders, also through outside pipes, which are heavily lagged to prevent condensation, as are also the pipes from the throttle. This portion of the piping is, of course, all high pressure, but no special importance attaches to it, as there is no movement in the pipes, the high-pressure engine being attached rigidly to the boiler. There is therefore no chance of leakage if the joints are properly made.

The steam exhausts from both high-pressure cylinders into a common header or receiver bolted over the ends of the steam chests; this header connects by a 7-in. pipe to a similar one on the low-pressure cylinders, which connection, however, must be flexible, as the movement of the front truck begins to affect the piping at this point, and to minimize its effect the connection has been placed directly over the pivot point of the front truck. The receiver pipe between the two headers extends upward about 6 ft., which was done to give sufficient volume, and this pipe, down to the point where it enters the low-pressure header, is braced solidly to the boiler and the connection which bolts to the low-pressure steam chest rotates about it, due to the move-

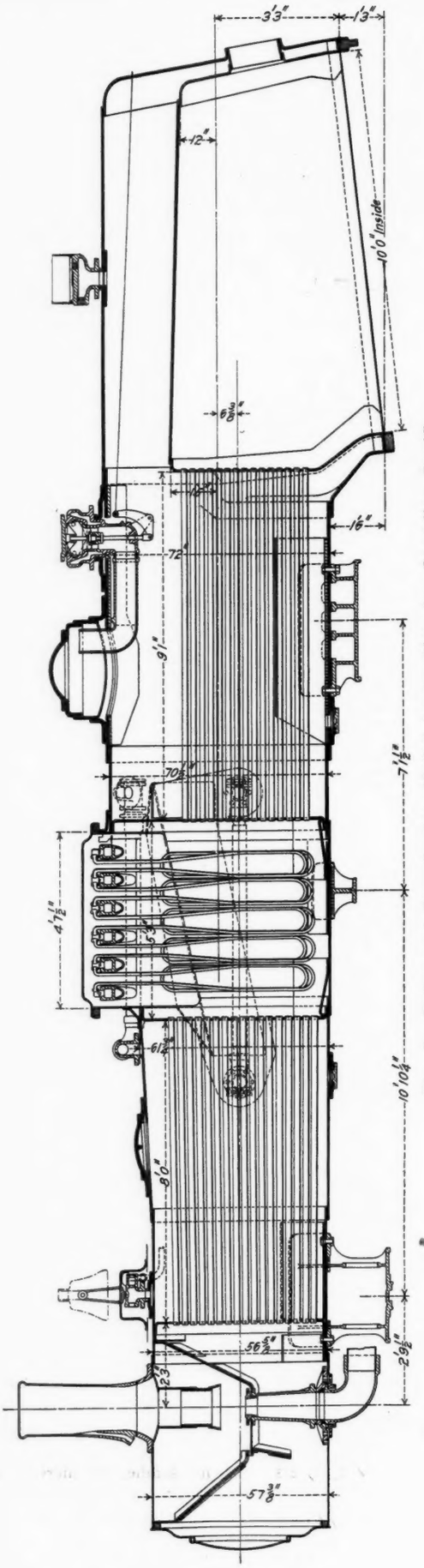


Fig. 2—Boiler and Superheater, Mallet Locomotive for Canadian Pacific.

ment of the front engine. This rotation is about 5 deg. on a 20-deg. curve, which is the greatest the locomotive will be called on to traverse. The joint is packed with alternate cast-iron and babbitt packing rings, and is the only one in the pipe system in which packing is used.

The exhaust pipe connects to the cylinder and underside of the smokebox by ball joints, and both ends have a small rotary movement, but as the angular movement is only 2 min. 34 sec. on a 20-deg. curve, the extension between the connections is only ⅜ in., which is taken up by the sliding of the pipe flanges on the flat faces of the ball rings. The flanges are held to their seats on the ball rings by 10 springs of 200 lbs. capacity each, or a total of 2,000 lbs. The extension due to the truck movement being provided for in this way, the use of the packed expansion joint is unnecessary. The arrangement of this portion of the piping, which may be called the low-pressure system, is shown by Fig. 3. The dotted lines show the movements of the pipes on a 20-deg. curve, and the diagram underneath shows the movements of the pipes as they would have been if the low-pressure cylinders were at the front of the engine. A comparison of the two arrangements shows that, with the cylinders at the front, the angular movement of the exhaust pipes would be 15 deg. 19 min. and its extension 1⅝ in., which would necessitate the use of two universal ball joints with packing and a packed expansion joint instead of the two simple ball rings, which are sufficient to take up both the rotary movement and extension. The receiver pipe movement would be the same, provided the connection to the high-pressure cylinders was directly over or close to the frame connection pin. The pipe is usually given flexibility by a packed universal ball joint and a packed expansion joint. From this it will be seen that, with the low-pressure cylinders at the front, and following the usual pipe construction, five packed joints would have been used, but with the arrangement adopted there is only one packed joint and two ball rings.

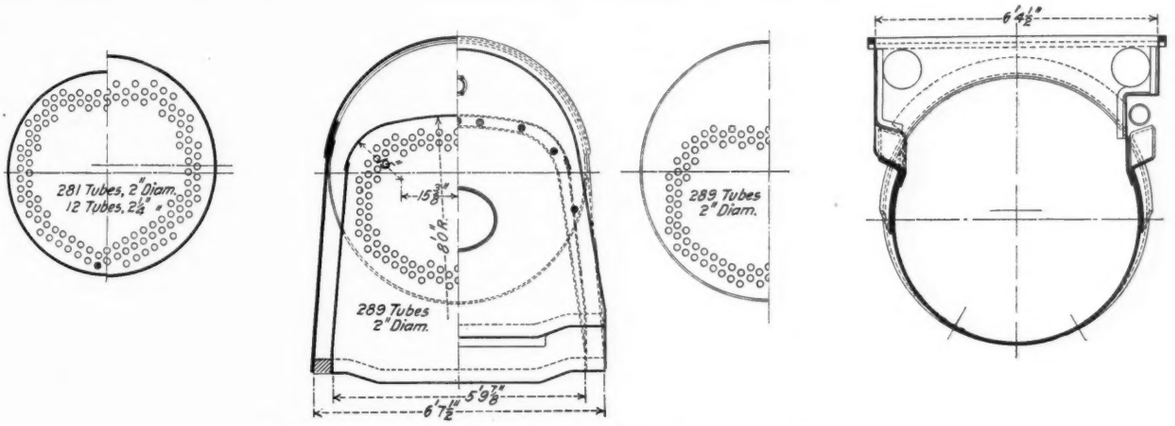


Fig. 2A—Cross-Section Through Boiler for Mallet Locomotive.

Cylinders, Valves, and Valve Motion.—The cylinders are of the piston valve type, with inside admission on the high pressure and outside on the low pressure, which permits of the most satisfactory arrangement of steam pipes. The diameters are: High pressure, 23¼ in. x 26 in.; low pressure, 34 in. x 26 in. All four are cast separately, without saddles, and are bolted together by vertical flanges in the usual manner. The high pressure have a cast-steel saddle which is common to both cylinders, and which bolts rigidly to them and to the boiler. This connection to the boiler is a very important one, the barrel being under pressure at this point, and the saddle is secured with 1¼-in. bolts, having a taper of ⅛ in. in 12 in., driven into holes reamed from the pressure side.

The low-pressure cylinders have no saddle, as there is a movement between the boiler and truck at this point. A small steadying casting has, however, been applied, which slides across the flat surface on the top of the cylinders, but no weight is transmitted to the truck by it. The main frames are slabbed to a section 15 in. deep x 3 in. wide at the cylinder fits, and are braced laterally by the frame connection castings which join the two engines together. The arrangement of the cylinders and their fastening is shown by Fig. 4.

Walschaert valve motion is used. The design varies but slightly from that used on other Canadian Pacific locomotives, except in the radius bar lifting link on the low-pressure engine, which, of course, must have flexible connections to permit of movement between the boiler, to which the reversing arm is attached, and the truck. It must also be made as long as possible, as when the locomotive is rounding a sharp curve the boiler will swing about 9 in. off the center line of the track at this point, and the angle taken by the lifting link causes the radius bar to raise in the radius link, thus shortening the travel of the valve when the engine is in forward gear and lengthening it when in backward, the radius bar being down for forward and up for backward gear. This applies to all Mallet locomotives having the radius bar suspension arranged in this manner, but is comparatively unimportant if sufficient clearance is allowed between the radius link and the block at the top.

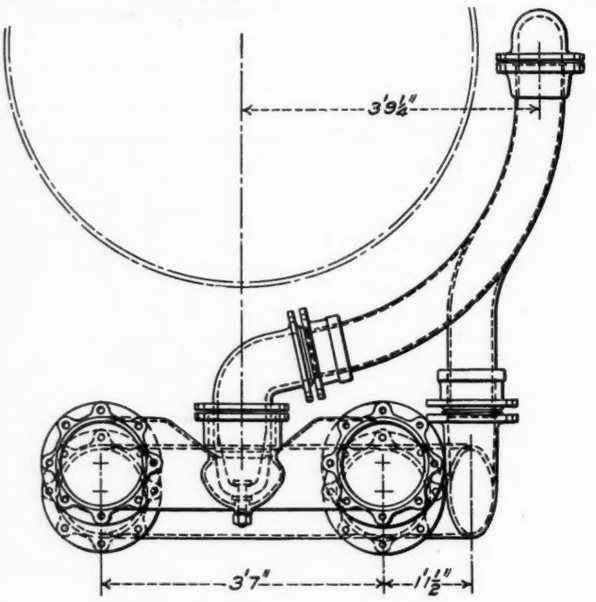
Provision has also been made for varying the cut-off in the low-pressure cylinders independently of the high pressure. That is, the low-pressure cut-off may be lengthened or shortened without affecting the high pressure. The high-pressure reverse shaft has two arms on the right-hand side. One of these is 11½ in. long, and is connected to the power reverse cylinder, the stroke of which is 12 in., and as the high-pressure radius bar lifting arm is forged to the same shaft, the lift or fall of the radius bar is always proportional to the travel of the power cylinder piston. The arm on this shaft, to which the low-pressure reach rod connects, has a slotted upper end with a sliding block, to which the reach rod pin connects. This block is held in any desired position by means of a screw adjustment. The shortest length of the arm is 12½ in., and with the longest power piston travel of 12 in. the movement of the reach rod is $\frac{12}{11.5} \times 12.5$, or 12 in., nearly. If, by means of the screw, the reach rod block is moved up to 14 in. from the shaft, the movement of the reach rod becomes $\frac{12}{11.5} \times 14$, or 14.6 in, with a consequent increase in the rise or fall of the low-pressure bar, which will increase the travel of the valve.

A simple form of power reverse gear is used, consisting of a 6-in. steam cylinder, with its piston rod connected to the reach rod shaft as described above. Rapid movement is prevented by an oil dash pot, the piston of which is connected to the same rod as the piston of the power cylinder.

Frames, Spring Rigging, and Weight Distribution.—The frames on each engine are in one piece and are slabbed for the cylinder fits and for the front bumper and back footplate, which makes a very simple arrangement, there being no frame splices

to break or get loose, and at the same time it gives a stronger cylinder fastening. The sections of the top and bottom rails are 4½ in. wide x 4½ in. deep, top, and 4½ in. wide x 3 in. deep, bottom, on both frames. Owing to the rather unusual conditions of weight distribution, the design was gone into very carefully and the sections were not only checked against the piston thrust, which is usually all that is considered, but against the weights carried by the frames. The bending moment and shearing forces for the front engine are shown by Fig. 5. These have been worked out considering the frame as a beam supported at four points (where it rests on the springs), the reaction being equal to the sum of the loads supported by the springs.

Fig. 5 shows that the proportion of the boiler weight carried by the front engine is concentrated at a point midway between the first and second wheels, or 31 in. ahead of the middle wheel, and as this is the only point on the front truck at which the boiler is supported, the weight must be such that its moment about the center of the truck will equal the moment of the weight of the front truck itself acting at the distance its center of gravity is located in rear of the center of the truck. On most Mallet locomotives now in service this is not the case. The actual point of support of the boiler on the frames is set forward (considering a truck with the cylinders at the front) of the virtual point sufficiently far to make the moment of the truck weight considerably greater. This is done to prevent rocking in a longitudinal direction, and, of course, tends to allow the truck to drop at the front, to correct which a suspension bolt working on ball seats connects the lower rail of each back engine frame to the upper rails of the front engine, and any tension put on them by screwing up on the adjusting nuts pulls down on the rear end of the front engine frame, correcting the effect of the center of gravity of the front system falling ahead of the center of the truck. On the Canadian Pacific Mallet this rocking effect is checked by the frame connection castings, which have jaws that interlock in such a manner as to make longitudinal rocking impossible.



The arrangement of these castings and their pin connection is clearly shown in Fig. 4. The construction at the joint is very substantial. A turned pin 4 in. in diameter is used, and with this arrangement of interlocking jaws the pin is put in triple

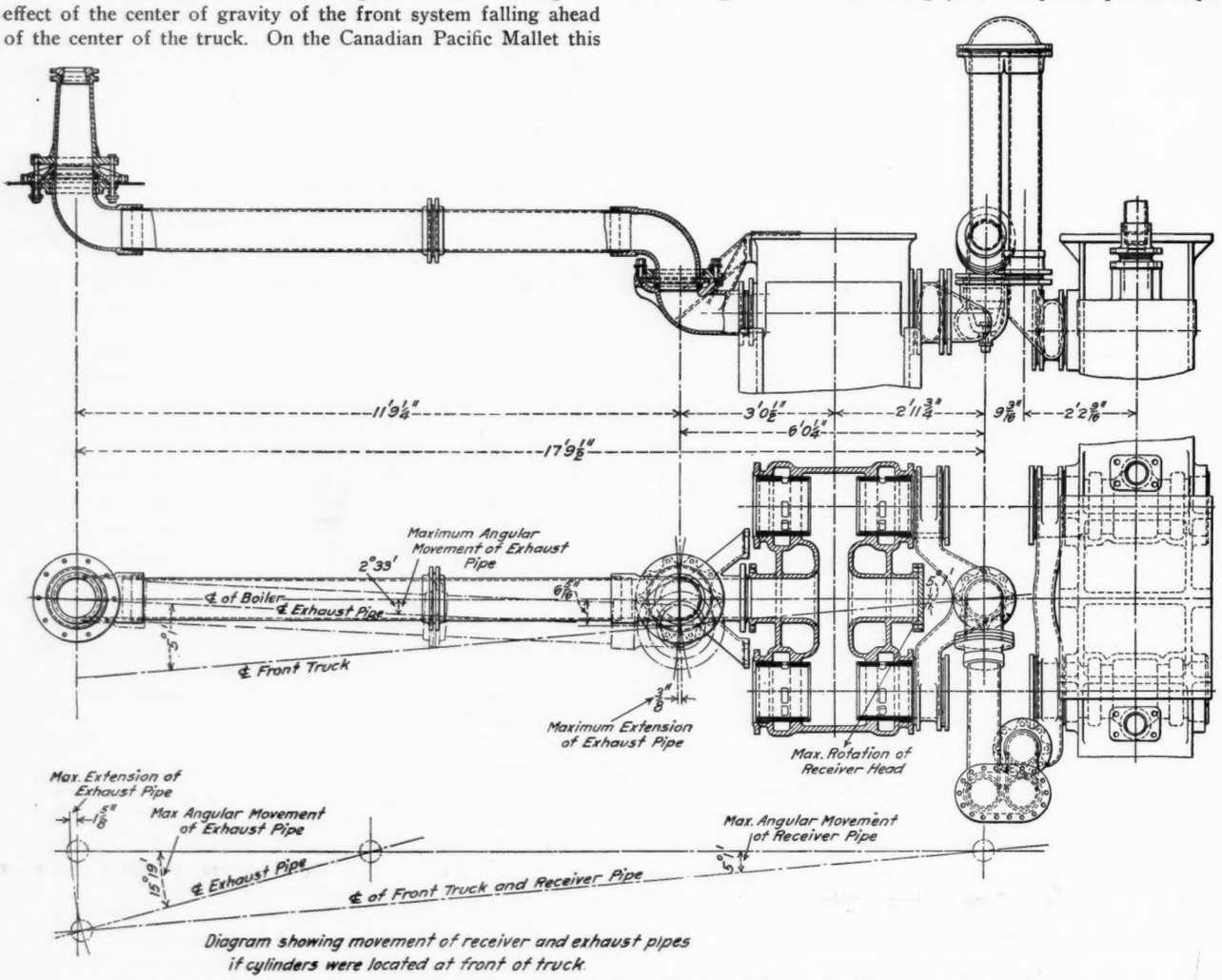


Fig. 3—Steam, Exhaust and Receiver Pipes. Dotted Lines Show Position on 20-Deg. Curve.

shear when pulling, but for buffing shocks, which are more severe, it is entirely relieved and the shock is taken up by the socket joint formed by the metal around the pin on the front casting fitting into a machined pocket on the back casting. As the extension of the exhaust pipe, due to the truck movement must be taken up by the sliding of the pipe flanges on the ball rings, and as only the rotary movement has been provided for on the receiver pipe, the importance of having a solid connection for the frames of the two engines is seen.

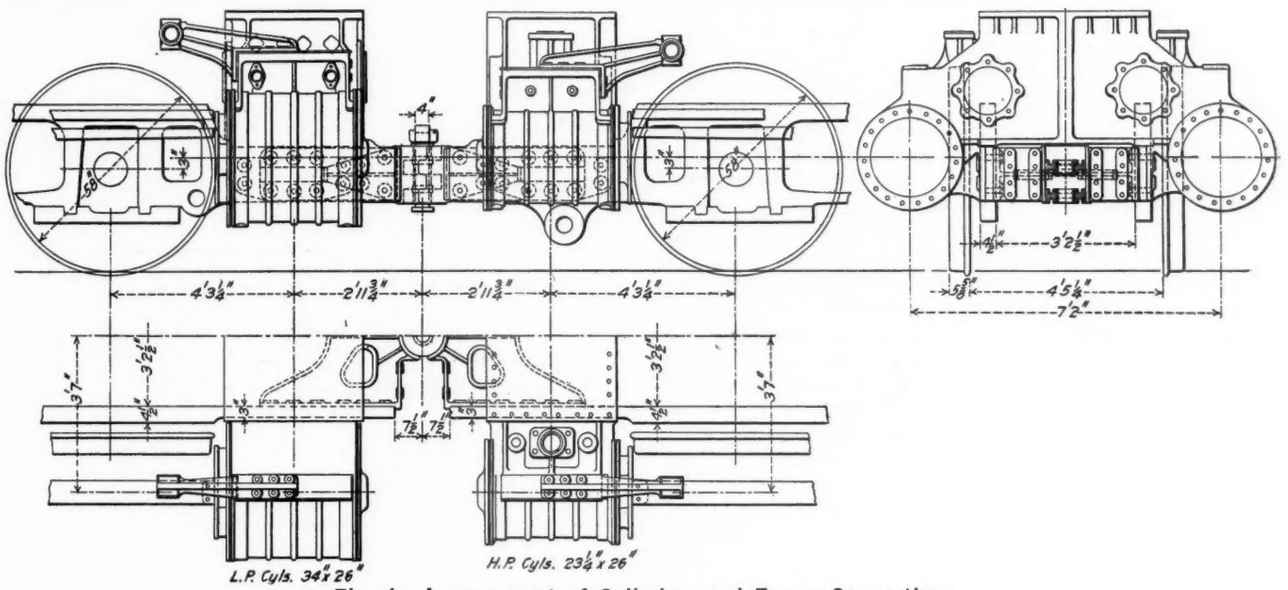


Fig. 4—Arrangement of Cylinders and Frame Connections.

The spring rigging is of an ordinary type. The front engine is equalized from back to front and has a cross equalizer at the front. The rear engine is also equalized through its whole length, but has no cross equalizers. The weights carried by the front and back engines are not equal, but are so distributed that approximately 9,000 lbs. more weight is carried by the front than by the back. As the effect of pushing or pulling a train is to reduce the weight on the front truck, and the service for which the locomotive was built calls for continued maximum tractive effort for considerable distances, it is important that the ratio of adhesive weight to tractive power be sufficiently high to ensure the engine holding the rail. As this ratio is 4.57, which is about as low as is desirable, it will be seen that any transfer of weight from the front truck would further reduce the adhesion factor and tend to make the front engine slip.

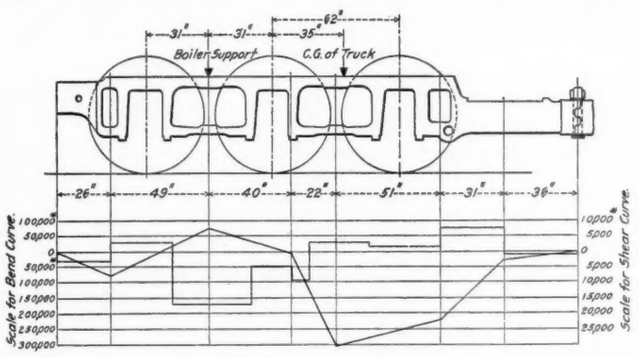


Fig. 5—Diagram of Bending Moment and Shearing Forces.

Guiding Power of the Front Engine.—Mallet articulated locomotives are built both without and with guiding trucks, and in most cases where leading trucks are used a truck is also placed at the rear end, back of the last pair of drivers. The theory advanced for omitting these trucks is that, in going ahead the front engine is in itself a truck and the front drivers are able to enter a curve against the resistance of the boiler without causing undue flange pressure or danger of derailing. On the other hand, those who advocate the use of trucks do not believe as safe an engine can be obtained without as with them. In any case, more advantages and better arguments can be advanced for eliminating the truck, such as the decrease in the total length of the engine, saving in weight, etc., and it can also be shown that the flange pressure is sufficiently low to ensure perfect safety.

On the Canadian Pacific locomotive trucks are not used, and the weight of the boiler, which offers the principal resistance to curving, as the truck must swing laterally underneath it, is supported partly by friction plates and partly by a spring suspended roller. The arrangement of this device is shown by Fig. 6, and its construction and action are as follows. There are two main castings, one of which is mounted on the frames, the other bolted solidly to the boiler moves with it, across the frame casting. The weight of the boiler and attachments resting on the front truck at this point is 40,000 lbs., and one-half of this, or 20,000 lbs., is carried on friction plates, four of

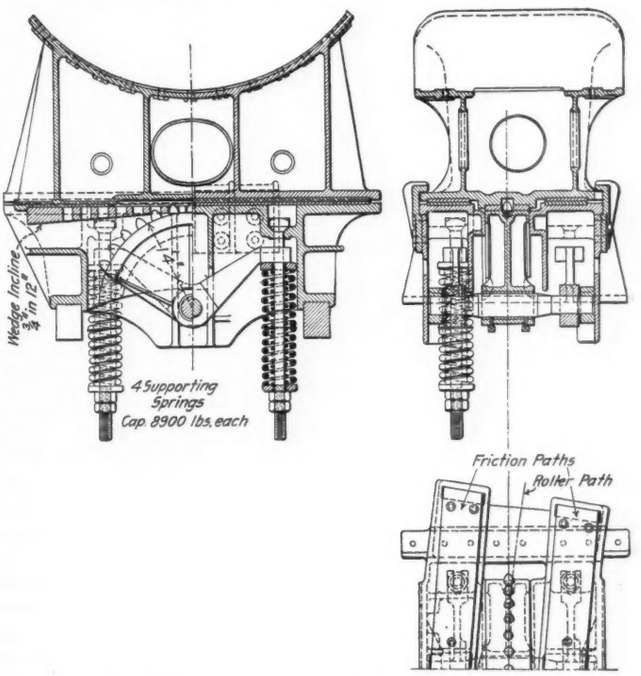


Fig. 6—Boiler Bearing and Guiding Device.

which are set on each casting, forming two approximately radial paths, with an 8¾-in. space between. The total area of these plates is 834 sq. in., and provision has been made for lubrication, each plate having oil grooves connecting with an oil box on the top casting. Under these conditions the coefficient of friction may be taken as .08, which gives 1,600 lbs. at starting as the resistance due to friction. This resistance decreases slightly, as will be explained later. In the 8¾-in. space between the two friction paths on the upper casting is the roller path, which consists of two wedge-shaped blocks, having an incline of ¾ in. in 12. These are set with their thin ends at the center line between the frames, and these ends have also been made flat for a distance of 2 in. on each side of the center.

The roller on which the inclined blocks travel is carried by two equalizers supported on springs, which in turn are carried by the bottom castings, and any movement of the truck sideways, as when entering a curve, causes the inclined blocks to force the roller downward against the resistance of its supporting springs, which produces a force to pull the boiler around the curve with the truck and relieve the leading flanges of the back engine from the excessive pressure which would otherwise result. The greater the movement of the truck sideways, the greater will be the deflection of the springs, and there will be a constantly increasing rolling resistance, as shown by the truck-guiding power chart, Fig. 7, reference to which shows the curve marked "rolling resistance" as starting at a point which corresponds with the beginning of the incline, or 2 in. from the center. The resistance at this point rises immediately to 1,250 lbs. and increases to 1,765 lbs. at 15¾ in., or the maximum movement sideways.

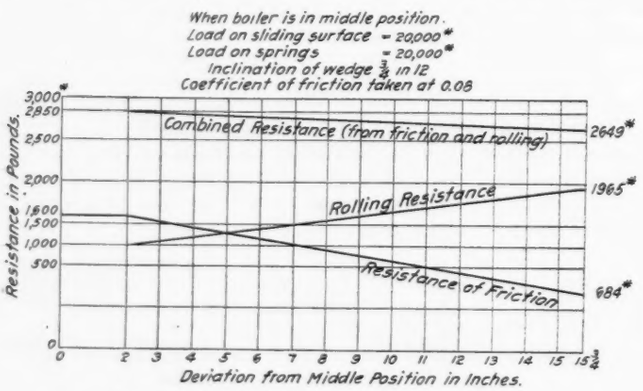


Fig. 7—Guiding Power of Front Truck.

As mentioned above, the frictional resistance decreases slightly. This is due to the reduction of weight on the friction paths as the truck moves sideways, caused by the additional weight carried by the springs and, consequently, by the roller also. The decreasing frictional resistance is shown by the drop in the curve marked "frictional resistance," and begins 2 in. from the center or the point where the roller picks up weight. The total resistance offered by the boiler to the truck moving sideways is shown by the curve marked "combined resistance." When the locomotive is entering a curve, for the first 2-in. truck movement to either side the resistance is only that due to friction, or 1,600 lbs. When straightening out, as on leaving a curve, the inclined surfaces tend to slide the boiler back to its normal position on the center of the truck against the increasing frictional resistance, thus relieving the pressure on the flanges. The resistance may be entirely altered by changing the inclination of the wedges, or the amount of rolling or frictional resistance may be varied at will by screwing up or slacking off on the roller supporting spring nuts, which has the effect of increasing the weight on the roller and decreasing the weight on the friction plates, or *vice versa*. The total resistance, however, would not be materially altered, unless the incline of the wedges was changed, which may easily be done by raising the boiler at the front, as the wedges are not cast solid with the top casting, but are held in pockets in it.

TESTS.

As stated at the beginning of this paper, the locomotive was of an experimental nature, and a number of tests were made to determine if the desired results were being obtained. These tests were not directed towards the amount of coal and water consumed or the economy of the machine as compared with other heavy road locomotives, but were more as a check on the design in general, to show what changes would be desirable in locomotives of the same type constructed in future.

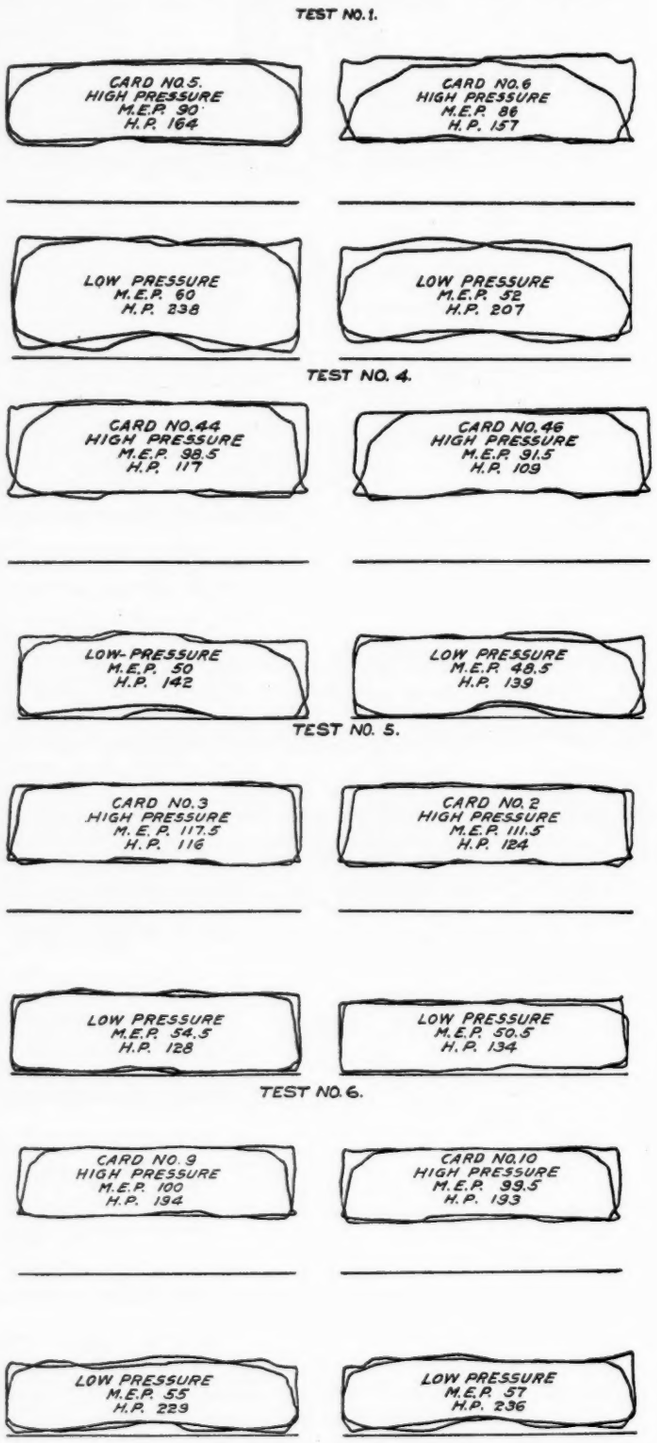

TEST NO. 1.
CARD NO. 5. HIGH PRESSURE M.E.P. 90 H.P. 164
CARD NO. 6 HIGH PRESSURE M.E.P. 86 H.P. 157
LOW PRESSURE M.E.P. 60 H.P. 238
LOW PRESSURE M.E.P. 52 H.P. 207
TEST NO. 4.
CARD NO. 44 HIGH PRESSURE M.E.P. 98.5 H.P. 117
CARD NO. 46 HIGH PRESSURE M.E.P. 91.5 H.P. 109
LOW-PRESSURE M.E.P. 50 H.P. 142
LOW PRESSURE M.E.P. 48.5 H.P. 139
TEST NO. 5.
CARD NO. 3 HIGH PRESSURE M.E.P. 117.5 H.P. 116
CARD NO. 2 HIGH PRESSURE M.E.P. 111.5 H.P. 124
LOW PRESSURE M.E.P. 54.5 H.P. 128
LOW PRESSURE M.E.P. 50.5 H.P. 134
TEST NO. 6.
CARD NO. 9 HIGH PRESSURE M.E.P. 100 H.P. 194
CARD NO. 10 HIGH PRESSURE M.E.P. 99.5 H.P. 193
LOW PRESSURE M.E.P. 55 H.P. 229
LOW PRESSURE M.E.P. 57 H.P. 236

Fig. 8—Typical Indicator Cards.

Special attention was therefore directed towards the following:

1. The receiver and exhaust pipes and their connections.

2. The boiler and machinery: whether the boiler was of sufficient capacity to supply steam to the cylinders, and what improvements could be made in the details of the latter.

3. The ability of the locomotive to curve freely, that is, traverse curves having a radius as short as any on which it would have to operate, and to do this at ordinary speeds, both heading and backing on, without danger of derailing, or excessive flange wear.

4. The ability of the locomotive to develop its calculated tractive effort.

5. The most satisfactory size of cylinders and arrangement of reheater or superheater, that is, what diameter of cylinder within the limits of 22 in. to 23¼ in. on the high pressure and 32½ in. to 34 in. on the low pressure would give the best results, using either reheated steam in the low pressure or superheated in the high pressure.

Of these, 1, 2 and 3 could be settled by observation of the locomotive when pulling the test trains and on a 20-deg. curve, as well as in the regular service later, while Nos. 4 and 5 necessitated the use of the dyamometer car and indicators. The locomotive was particularly adaptable to experiment as to the size of cylinders and arrangement of reheater or superheater. The cylinders had bushings which would permit of varying their diameter and the outside arrangement of steam pipes made possible the use of a reheater for the high pressure exhaust or a superheater in direct communication with the boiler at small cost.

It was apparent from the first that the receiver and exhaust pipes would do what was expected of them, and during the period of about 10 days when the locomotive was under test and 3 weeks' observation subsequently during regular service, no leakage of steam developed, nor was it even necessary to tighten up on the packing gland on the receiver pipe or the bearing plates of the sliding ball rings on the exhaust pipe. Owing to its length, the exhaust pipe has considerable capacity as a receiver, and the exhaust is very mild, but this may be considered as an advantage, as no difficulty is experienced in maintaining full steam pressure. Some leakage developed around the taper bolts which hold the high pressure cylinder saddle to the boiler, and on future locomotives other systems of fastening will be considered.

All curves were traversed freely, both heading and backing on, and, from observations made on a "Y" on which the rails were light and the curvature about 18 deg. at one point, it was proved conclusively that the articulated locomotive did less damage and curved easier than an ordinary 2-8-0 locomotive, weighing 185,000 lbs., with a rigid wheel base of 15 ft. 10 in. and a total wheel base of 24 ft. 4½ in., the pony truck having 5 in. x 8-in. three point hangers. The amount of flange wear after about 4,000 miles was $^{3}/_{64}$ in. at the point of contact between the rail head and flange on the leading wheels, and $^{1}/_{32}$ in. on other wheels, which is satisfactory service, considering the crookedness of the track on which the locomotive is operating, there being a large number of 10-deg. curves. This amount of wear also compares very favorably with that on other locomotives in the same service.

The sizes of the cylinders on the locomotive as first turned out were 22 in. and 32½ in. x 26 in., or a ratio of 2.18, and the exhaust from the high-pressure pair passed through the reheater before entering the low-pressure steam chest. Three other combinations of cylinders and position of reheater or superheater were tried, and altogether six tests were made before the final sizes of the cylinders were determined.

A large number of indicator cards were taken, and those shown in Fig. 8 are fairly representative of each test. In the "Summary of indicator cards" the measure of steam at cut-off is expressed in terms of the following:

"Steam at cut-off = (T.P. per lb. M.E.P. × cut-off, per cent. + T.P. per lb. M.E.P. × clearance, per cent.) × pressure at cut-off + 14.7."

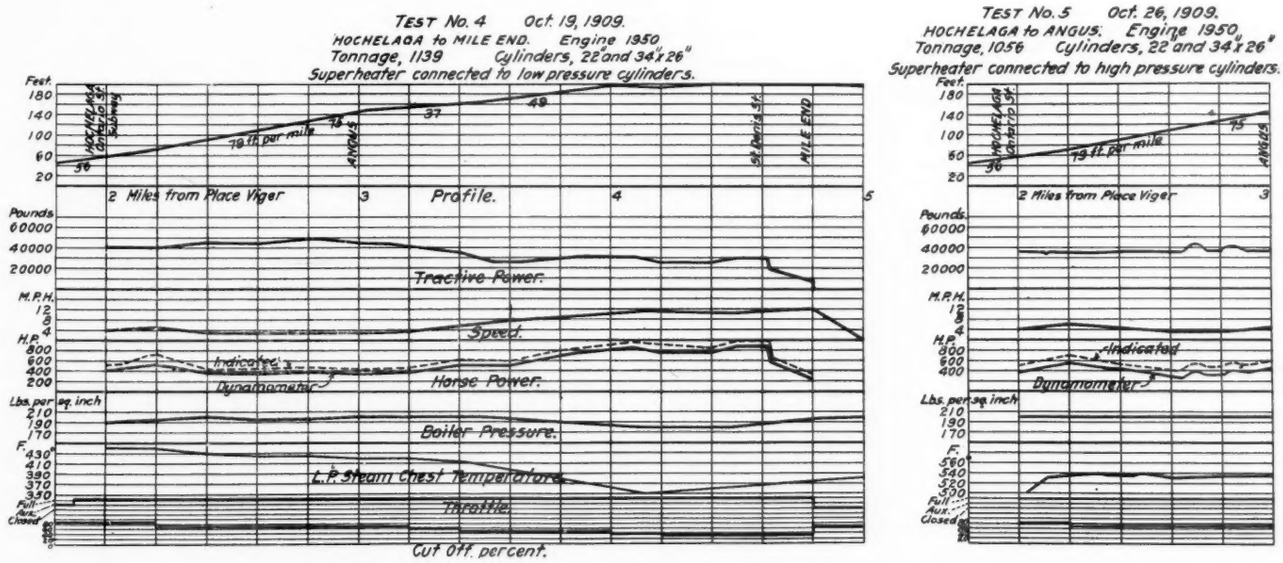


Fig. 9—Dynamometer Car Record.

Fig. 9 shows the dynamometer car record, indicated and dynamometer horse powers, speed, boiler pressures, etc., for tests 4 and 5. In tests Nos. 1, 2 and 3, which were made under similar conditions, it was found that there were practically equal amounts of steam in each pair of cylinders, and that the low-pressure cylinders were developing considerably greater power than the high pressure. This condition can best be accounted for by the increased volume of steam in the receiver, due to its being reheated and consequently expanded, causing excessive back pressure on the high-pressure pistons, as indicated by the drop in pressure between the back pressure line on the high-pressure cards and the admission line on the low pressure.

To more nearly equalize the power, it was decided to increase the diameter of the low-pressure cylinders to 34 in., or a ratio of 2.38, which would have the effect of emptying the receiver more rapidly, with a consequent decrease in the back pressure and rise in mean effective pressure on the high-pressure pistons without materially changing the amount of work done by the low pressure. The reheater was left connected to the receiver, the lack of condensation at the cylinder cocks being very noticeable, which was a desirable feature. The maximum temperature obtained in the low-pressure steam chest, using reheated steam, was 440 deg., which, with a pressure of 75 lbs., would give 120

deg. superheat. The result of this arrangement is shown by test No. 4, and made considerable improvement in the distribution of power, althought the equalization could still be improved.

At the conclusion of this test the reheater pipes were changed to connect to the high-pressure steam chest and the receiver pipe, as shown by Fig. 3, was applied. Superheated steam would thus be used in the high-pressure cylinders and the exhaust would pass direct to the low-pressure steam chest.

SUMMARY OF INDICATOR CARDS.

Test No.	Card No.	M.E.P.	H.P.	Indicated tractive effort.	Steam at cut-off. Measure.	Pr. ct.	Work in cylinders. Pr. ct.	Tractive effort. Total.	Horse power Total.
1—5	H.P.	90	164	19,500	37,700		41		
5	L.P.	60	238	28,500	37,600	99¾	59	48,000	804
6	H.P.	86	157	18,650	35,800		43		
6	L.P.	52	207	24,700	32,320	96	57	43,350	728
4—44	H.P.	98.5	117	21,300	41,000		45		
44	H.P.	50	142	26,000	38,750	95	55	47,300	518
46	H.P.	91.5	109	19,800	40,950		44		
46	L.P.	48.5	159	25,200	38,600	94	56	45,000	496
5—2	H.P.	111.5	124	24,200	42,500		48		
2	L.P.	50.5	134	26,300	37,300	87½	52	50,500	516
3	H.P.	117.5	116	25,550	44,250		47½		
3	L.P.	54.5	128	28,200	39,100	88	52½	53,750	488
6—9	H.P.	100	194	24,300	48,000		46		
9	L. P	55	229	28,600	40,100	83¾	54	52,900	846
10	H.P.	99.5	193	24,150	47,400		45		
10	L.P.	57	236	29,600	40,750	86	55	53,750	858

For "Steam at Cut-off Per Cent." the largest measure in each pair of cards is taken as 100 per cent.

Test No.					Ratio.					
1	Cylinders	22 in.	and	32½ in.	x 26 in.	2.18,	Reheater	connected	to	L.P.
2	"	22 "	"	32½ "	26 "	2.18,	"	"	"	"
3	"	22 "	"	32½ "	26 "	2.18,	"	"	"	"
4	"	22 "	"	34 "	26 "	2.38,	"	"	"	"
5	"	22 "	"	34 "	26 "	2.38,	Superheater	"	"	H.P.
6	"	23¼ in.	and	34 in.	x 26 "	2.14,	"	"	"	"

The amount of steam shown by the low-pressure indicator cards in test No. 5 now averaged about 87 per cent. of that shown by the high-pressure cards, and the total amount of power as calculated from the series of indicator cards was approximately the same for the two engines.

It was next decided to try and increase the total power of the locomotive, which could still be done, as the factor of adhesion could be reduced without going below safe limits. The most satisfactory ratio, as indicated by the previous tests, would have been 2.38, as shown by test No. 5, but as the bushing had been removed from the low-pressure cylinder, its diameter could not be further increased, and the high-pressure only were changed, their diameter being increased to 23¼ in., or a ratio of 2.14. Although the low-pressure cylinder diameters could not be increased, their cut-off could be lengthened by means of the adjusting arm previously described, without changing the cut-off in the high pressure, which would have a similar effect in reducing the back pressure on the high-pressure pistons.

The results obtained with this arrangement are shown by test No. 6, and, everything considered, it was the most satisfactory which had been tried. The power had been increased, and the amounts developed by each engine were reasonably well balanced. The decrease in the measure of steam in the low-pressure cylinders, due to the position of the superheater, is well illustrated in this test by comparing it with No. 1, in which the amounts are very nearly equal.

As the tests just described indicated that the best results would be obtained with cylinders 23¼ in. x 26 in. on the high-pressure engine and 34 in. x 26 in. on the low, and with the high-pressure cylinders taking steam from the superheater, the locomotive was therefore put into regular service in the Rocky mountains, pushing on the grade eastward from Field to Stephen. The maximum grade is 2.2 per cent. and there are two spiral tunnels 2,800 ft. and 3,200 ft. long, having a radius of 573 ft. The regular locomotives working on this and similar grades in the Rocky mountains have general dimensions as follows:

Type	2-8-0
Class	M-4
Cylinders	21 in. × 28 in.
Driving wheels, diameter	58 in.
Boiler pressure	200 lbs.
Weight on drivers	168,000 "
Weight, total	185,000 "
Tractive effort	36,200 "
Factor of adhesion	4.65

Their full rating in summer is 424 tons, and on the same basis the Mallet locomotive should handle 660 tons, which it does without trouble, and has also taken up 700 tons, which may be considered the maximum tonnage for this grade. Dominion coal was used on the tests made at Montreal. This is a friable, rather fine coal, and an aerage of the analyses of 25 samples gives the fixed carbon as 55.71 per cent, and the heat value 13,729 B.t.u's. That used in regular service is known as Canmore coal, and is mined in the Rocky mountains. It is much finer than the Dominion coal and very dusty, and must be thoroughly wet down before firing, otherwise a considerable percentage goes up the stack in the form of cinders. It is higher in fixed carbon than the former, but the heat value is about the same. The locomotive steamed as successfully with the Canmore coal as it did with Dominion coal, although adjustments were necessary in the smokebox diaphragm and draft pipes, the diameter of the exhaust nozzle with both coals being 4¾ in.

Fig. 10 is the log of what may be considered a representative trip of the locomotive in regular service on the Field Hill, and is chiefly interesting as proving that the boiler is of ample capacity to supply steam to the cylinders. This also shows the temperatures and pressures in the high and low pressure steam chests. The maximum temperature shown in the high

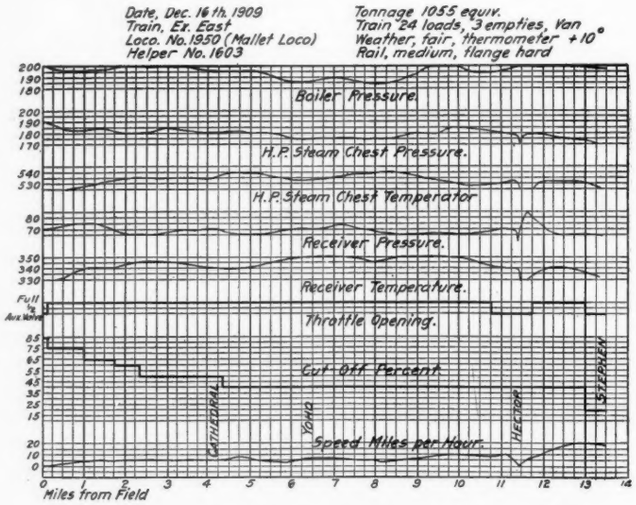


Fig. 10—Log of Steam Pressures and Temperature.

pressure steam chest was 540 deg., or 153 deg. superheat. An average of a number of trips shows a temperature of 535 deg., or 148 deg. of superheat, which is reached soon after a train is started, and remains practically constant, irrespective of boiler pressure, cut-off, throttle position or speed. The maximum temperature shown in the receiver pipe was 350 deg., and the average was about 345 deg. As the pressures ranged from 60 lbs. to 75 lbs., this would give from 38 deg. to 25 deg. superheat in the receiver. The amount of condensation in the low pressure cylinders is very small, and the cylinder cocks are closed after a few revolutions, which, of course, tends to decrease the water consumption.

As the locomotive has not been in service sufficiently long, no figures are available as to cost of maintenance, but it is to be expected that, as there is practically double the amount of machinery, this will be somewhat higher than on the consolidation locomotives in the same service. The operating costs will be slightly higher when considered on a locomotive mile basis. The same crews do the work for the same wages, but more lubricant, waste and sand must of necessity be used, and the cost of wiping and cleaning will also be higher. On a ton basis, which is the fairest comparison for operating cost, it will be lower, due to the greater tonnage hauled, which, it is considered, together with the saving in fuel, will show considerable economy in favor of the Mallet locomotive.

General News Section.

Several alleged cases of violation of the 16-hour law on the San Antonio & Aransas Pass have been reported to the Interstate Commerce Commission.

According to newspaper despatches, the Southern Pacific has been making successful trial trips east of Sparks, Nev., with the Mallet locomotives which have been in service west of Sparks.

The Atchison, Topeka & Santa Fe lately received an experimental lot of 8,000 ties from Mexico. They are of mahogany, ebony, native cedar and various other woods. The company is also getting some ties from other foreign countries for the same purpose.

The Indiana Railroad Commission, in answering questions as to whether suits for violation of the state safety appliance law would be dismissed if the defendant companies agreed to remedy safety appliance defects, says that it will insist upon penalties being collected.

The St. Louis Railway Club is offering a scholarship at Washington University, St. Louis, Mo. To enter the university the candidate must have a high school education, and to enter this competition must be the son of a member of the St. Louis Railway Club in good standing. Benefits under this scholarship amount to $250 a year. Applications must be in the hands of the secretary not later than noon, August 12, 1910.

A series of tests have been made on the testing plant at Purdue University of a Chicago & North Western locomotive equipped with a front end designed to eliminate sparks. Different fuels were used and the locomotive was operated under various conditions. The tests are said to have been satisfactory—so much so that it will probably be possible to burn lignite successfully with the new device. It is expected that the new front end will shortly be thoroughly tried out in road service.

The gas-electric car built by the General Electric Co., Schenectady, N. Y., for the Southern Railway (*Railway Age Gazette*, February 4, 1910, p. 285.) is now in operation on the line of the Southern Railway and the Blue Ridge Railway between Greenville, N. C., and Anderson, the intermediate territory being perhaps the most thickly settled milling section in the south, including the important points, Piedmont, Pelzer, Williamston and Belton. Two round trips a day are made. Though a large number of stops are made, the car has no trouble in making the schedule time. The car now in use is the property of the General Electric Co. and will be used until two cars being built by that company especially for the Southern Railway are delivered. The new cars will provide seats for 57 passengers. The new service is in addition to the steam trains run between Greenville and Anderson.

Pennsylvania Station at New York.

The new Pennsylvania Railroad station at New York was declared officially open on August 1 by President McCrea, who accepted from the Memorial Committee of the Board of Directors a statue of the late president, A. J. Cassatt. Trains will run into the station under the East river on regular schedule, beginning September 8.

Samuel Rea, second vice-president of the Pennsylvania Railroad, opened the exercises, saying: "We are here to-day to honor the memory of the late president of the Pennsylvania Railroad, A. J. Cassatt, and to unveil his statue as a tribute to his genius. Mr. Cuyler, chairman of the Memorial Committee, will now present the statue to the company and Mr. McCrea, president, will, on its behalf, accept the same."

T. De Witt Cuyler said: "We are gathered here to-day to take part in an event which marks one of the most important epochs in the history of the Pennsylvania Railroad. With the unveiling of the statue, before which we stand, it is proposed, sir, that you should officially declare the station open for the purposes for which it was built.

"The occasion calls for no ostentatious ceremonies or elaborate words. These massive walls and columns speak in their severe simplicity and majestic silence with far more eloquence than human tongue could give utterance to, and so, too, this splendid statue which we are now to look upon, in the greatness of the genius and the simplicity of the character of the man, finds a fitting resting place amid these surroundings.

"It has been at once the privilege and duty of the directors to have here placed this portrait of Mr. Cassatt, and how well the artist has done his work, all will attest.

"We ask you, as the head of this great corporation, to take this statue into your keeping and to unveil it to the public eye so that all men may know, as the inscription so aptly tells us, 'whose foresight, courage and ability achieved the extension of the Pennsylvania Railroad system into New York City.'"

President McCrea said: "On behalf of the Board of Directors of the Pennsylvania Railroad, I accept this noble statue of Mr. Cassatt. It is fitting and proper that its unveiling should be coincident with the official opening of the great terminal which the Pennsylvania Railroad has, prompted by his foresight and courage, builded for itself in this, America's greatest city.

"As the years roll around the greater will be the tribute to the genius of Mr. Cassatt, and it is a source of greatest pleasure to those who had the privilege of knowing him, to feel that there has been erected to his memory, in so fitting a place, a statue that will so truly express to those who follow, the manner of man he was.

"As a fitting conclusion to these ceremonies, I now declare this station officially opened."

Grand Trunk Strike Settlement.

The strike of conductors, trainmen and yardmen which began on the Grand Trunk and Central Vermont on July 18 was called off on August 2. Under the terms of the agreement signed by President Hays and the Union officials, the company will put back as soon as possible the men other than those who have been or may be found guilty of acts of violence or disorderly conduct, the understanding being that there is to be no coercion or intimidation used towards the new men. The company will put into effect from May 1, 1910, the rates named in its proposal dated July 18, those rates to be embodied in the present schedules now in effect on this line, it being understood that those rates shall in no instance effect a reduction in any existing rate. The company will on January 1, 1912, make effective in train and yard service on the Grand Trunk the rates of pay and the rules contained in the schedule or agreement on that date in effect on the lines of the Canadian Pacific east of Fort William. The same propositions shall apply also to the Central Vermont Railroad rates to be effective in 1912, in this case, instead of the Canadian Pacific rates.

The men get two concessions over the terms offered by President Hays on the afternoon of the day they struck. First, the standardization of pay and rules with those recently conceded by the Canadian Pacific takes place on January 1, 1912, instead of January 1, 1913, as offered by Mr. Hays, a gain of one year. The Canadian Pacific standard and rules are not quite those of Eastern roads in the United States, which the men demanded from the Grand Trunk, but slightly lower. Secondly, the offer made on July 18 is accepted, to hold until the standardization is adopted on January 1, 1912, but the increased rate of pay made in that offer is made retroactive, dating from May 1 last. The men, therefore, gain two and a half months of the increase, the offer of Mr. Hays being when made only effective from date. However, the men are only to be restored to their former positions "as soon as possible." The company is not under obligation to discharge any of the men it has taken on since the strike was called, nor to reduce them in rank.

Labor Negotiations.

The wages of enginemen on the Chicago, Indianapolis & Louisville have been increased from 10 to 20 per cent., effective July 1

Rioting is reported from Winnipeg, Man., at the Canadian Northern shops, where 500 car men are on strike. Cars were burned and special police are on duty.

The board of arbitration acting under the Erdman act has awarded an increase of 6 per cent. to the Missouri Pacific telegraphers.

An increase of 6 per cent. in wages has been given to employees in the bridge and building department of the New York, New Haven & Hartford.

The Missouri Pacific has made a settlement with its enginemen.

The Canadian Pacific has increased the wages of its enginemen 10 per cent.

The Pennsylvania Lines East and West of Pittsburgh have come to an agreement with their conductors and trainmen. The new schedules are similar to those on the New York Central, but the rates are understood to be somewhat higher.

Conductors and trainmen on the Ann Arbor Railroad have asked for increases in wages said to vary from 15 per cent. to 42 per cent.

Reports of attempted wrecking of trains by the striking track men on the Delaware & Hudson continue. North of Albany the track is being patrolled by armed guards, and at Carbondale, Pa., where there was rioting last week, additional forces of state troopers and special police are on duty. The mayor of Schenectady, N. Y., has been warned that the company will hold the city responsible, under the state statutes, for all damage to its property by the riot.

Enginemen on 56 roads west of Chicago are said to be formulating demands for increased wages.

The Bureau of Railway Economics.

The following announcement has been made, to correct wrong impressions: "The establishment of this bureau was decided on for the purpose of securing and compiling statistical data with reference to the various branches of the railway service so that the railways themselves may have an avenue of authentic unbiased information concerning the problems confronting them. In other words, an important officer of one railway may know of the workings of his own organization, but he also may be unfamiliar with facts from time to time relating to the general railway situation, and with the idea of furnishing freely data as between railway men the bureau was established.

"After its establishment was decided on, it occurred to the railway men that if they were not able themselves, under the present conditions, to know all the facts concerning other railway organizations, it was difficult to inform the public at large correctly concerning the whole situation. Therefore, it was determined, whenever the public or newspapers sought information pertaining to any particular question, that it should be freely furnished, but it is not intended that the bureau is to engage in a campaign of publicity."

Pennsylvania Railroad Relief Department.

According to the regular monthly report of the relief department of the Pennsylvania Railroad, $188,110 was paid to the members during June. Of this amount $137,805 represents the payments made on the Lines East of Pittsburgh and Erie and $50,305 on the Lines West. Since the establishment of the funds in 1886 a total of $28,658,001 has been paid out.

On the Lines East of Pittsburgh and Erie in the month of June the payments in benefits to the families of members who died amounted to $51,522, while to members incapacitated for work they amounted to $86,283. The total payments on the Lines East of Pittsburgh since the relief fund was established have amounted to $20,888,917.

In June the relief fund of the Pennsylvania Lines West of Pittsburgh paid out a total of $50,305, of which $20,940 was for the families of members who died and $29,365 for members unable to work. The sum of $7,769,083 represents the total payments of the relief fund of the Pennsylvania Lines West since it was established in 1889.

Association of Railway Electrical Engineers.

The annual convention will be held in the La Salle Hotel, Chicago, September 27-30. The exhibits will be located in the large ball room, which affords ample accommodation and a beautiful setting for the convention exhibits.

Matters pertaining to the various applications of electricity in railway operation, aside from telegraphy and signaling, will be considered at this convention, and it is thought that a large number of railway men will be in attendance.

MEETINGS AND CONVENTIONS.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting.

Air Brake Association.—F. M. Nellis, 53 State St., Boston, Mass.
American Association of Demurrage Officers.—A. G. Thomason, Scranton, Pa.; next meeting June 22, 1911; Niagara Falls, N. Y.
American Association of General Passenger and Ticket Agents.—C. M. Burt, Boston, Mass.; next meeting, St. Paul, Minn.
American Assoc. of Local Freight Agents' Ass'n.—G. W. Dennison, Penna. Co., Toledo, Ohio.
American Ass'n of Railroad Superintendents.—O. G. Fetter, Carew Bldg., Cincinnati, Ohio.
American Railway Association.—W. F. Allen, 24 Park Place, New York.
American Railway Bridge and Building Association.—C. A. Lichty, C. & N. W., Chicago; Oct. 18; Fort Worth, Tex.
American Railway Engineering and Maint. of Way Ass'n.—E. H. Fritch, Monadnock Bldg., Chicago.
American Railway Industrial Association.—G. L. Stewart, St. L. S. W. Ry., St. Louis.
American Railway Master Mechanics' Association.—J. W. Taylor, Old Colony Building, Chicago.
American Railway Tool Foremen's Association.—O. T. Harroun, Bloomington, Ill.
American Society for Testing Materials.—Prof. Edgar Marburg, Univ. of Pa., Philadelphia.
American Society of Civil Engineers.—C. W. Hunt, 220 W. 57th St., N. Y.; 1st and 3d Wed., except July and August; New York.
American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. 29th St., N. Y.; 2d Tues.; New York.
American Street and Interurban Railway Ass'n.—H. C. Donecker, 29 W. 39th St., New York; Oct. 10-14; Atlantic City.
Association of Am. Ry. Accounting Officers.—C. G. Phillips, 143 Dearborn St., Chicago.
Association of Railway Claim Agents.—E. H. Hemus, A., T. & S. F., Topeka, Kan.
Association of Railway Electrical Engineers.—G. B. Colegrove, I. C. R.R., Chicago; annual, Sept. 27-30; Chicago.
Association of Railway Telegraph Superintendents.—P. W. Drew, 135 Adams St., Chicago; June 19, 1911; Boston.
Association of Transportation and Car Accounting Officers.—G. P. Conard, 24 Park Place, New York.
Buffalo Transportation Club.—J. N. Sells, Buffalo.
Canadian Railway Club.—James Powell, Grand Trunk Ry., Montreal, Que.; 1st Tues. in month, except June, July and Aug.; Montreal.
Canadian Society of Civil Engineers.—Clement H. McLeod, Montreal, Que.; Thursdays; Montreal.
Car Foreman's Association of Chicago.—Aaron Kline, 841 North 50th Court, Chicago; 2d Monday in month; Chicago.
Central Railway Club.—H. D. Vought, 95 Liberty St., New York; 2d Friday in January, March, May, Sept. and Nov.; Buffalo.
Engineers' Society of Pennsylvania.—E. R. Dasher, Box 704, Harrisburg, Pa.
Engineers' Society of Western Pennsylvania.—E. K. Hiles, 803 Fulton Building, Pittsburgh; 1st and 3d Tuesday; Pittsburgh.
Freight Claim Association.—Warren P. Taylor, Rich., Fred. & Pot. R.R., Richmond, Va.
General Superintendents' Ass'n of Chicago.—H. D. Judson, 209 Adams St., Chicago; Wednesday preceding 3d Thursday; Chicago.
International Master Boiler Makers' Association.—Harry D. Vought, 95 Liberty St., New York.
International Railway Fuel Association.—D. B. Sebastian, La Salle St. Station, Chicago.
International Railway General Foremen's Association.—L. H. Bryan, D. & I. R. Ry., Two Harbors, Minn.
International Railway Master Blacksmiths' Ass'n.—A. L. Woodworth, Lima, Ohio; Aug. 16-18; Detroit, Mich.
International Railway Congress.—Executive Committee, rue de Louvain, 11 Brussels.
Iowa Railway Club.—W. B. Harrison, Union Station, Des Moines, Ia.; 2d Friday in month, except July and August; Des Moines.
Master Car Builders' Association.—J. W. Taylor, Old Colony Bldg., Chicago.
New England Railroad Club.—G. H. Frazier, 10 Oliver St., Boston, Mass.; 2d Tuesday in month, ex. June, July, Aug. and Sept.; Boston.
New York Railroad Club.—H. D. Vought, 95 Liberty St., New York; 3d Friday in month, except June, July and August; New York.
North-West Railway Club.—T. W. Flanagan, Soo Line, Minn.; 1st Tues. after 2d. Mon., ex. June, July, August; St. Paul and Minn.
Northern Railway Club.—C. L. Kennedy, C., M. & St. P., Duluth; 4th Saturday; Duluth, Minn.
Omaha Railway Club.—A. H. Christiansen, Barker Blk.; Second Wed.
Railway Club of Kansas City.—C. Manlove, 1008 Walnut St., Kansas City; 3d Friday in month; Kansas City.
Railway Club of Pittsburgh.—J. D. Conway, Pittsburgh, Pa., 4th Friday in month, except June, July and August; Pittsburgh.
Railway Signal Association.—C. C. Rosenberg, 12 North Linden St., Bethlehem, Pa.; annual, Oct. 11; Richmond, Va.
Railway S'keepers' Ass'n.—J. P. Murphy, Box C., Collinwood, O.
Richmond Railroad Club.—F. O. Robinson; 2d Monday; Richmond.
Roadmasters' and Maintenance of Way Ass'n.—Walter E. Emery, P. & P. U. Ry., Peoria, Ill.; annual, Sept. 13-16; Chicago.
St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo.; 2d Friday in month, except June, July and Aug.; St. Louis.
Society of Railway Financial Officers.—C. Nyquist, La Salle St. Station, Chicago; Oct. 25 and 26; Hotel Chamberlin, Old Point Comfort, Va.
Southern Association of Car Service Officers.—E. W. Sandwich, A. & W. R. Ry., Montgomery, Ala.; annual, Oct. 20; Atlanta.
Southern & Southwestern R.R. Club.—A. J. Merrill, Prudential Bldg., Atlanta; 3d Thurs., Jan., Mar., July, Sept. and Nov.; Atlanta.
Traffic Club of New York.—C. A. Swope, 290 Broadway, New York; last Tuesday in month, except June, July and August; New York.
Train Despatchers' Ass'n of America.—J. F. Mackie, 7042 Stewart Ave., Chicago.
Transportation Club of Toledo.—L. G. Macomber, Woolsen Spice Co., Toledo.
Traveling Engineers' Association.—W. O. Thompson, N. Y. C. & H. R., East Buffalo; annual meeting; Aug. 16-19; Niagara Falls, Ont.
Western Canada Railway Club.—W. H. Rosevear, P. O. Box 1707, Winnipeg; 2d Monday, except June, July and August; Winnipeg.
Western Society of Engineers.—J. H. Warder, Monadnock Bldg., Chicago; Wednesdays, except July and August; Chicago.

Traffic News.

Western trunk lines are said to be preparing to abolish terminal allowances to terminal and industrial roads controlled by shippers.

The Erie announces that of the 95 fast freight trains operated during June all but four reached their destination in time for the advertised markets.

The roads in the Western Passenger Association have agreed to make a round trip rate of a fare and a half for all state fairs held in western territory.

The Interstate Commerce Commission has instituted proceedings against the New York, New Haven & Hartford as to the advances in commutation rates.

The hearing in New York announced for October 15 in the matter of advanced rates in official classification territory will probably be postponed for about a week.

The Commercial Club of Duluth, Minn., proposes to begin action against interested roads for alleged discrimination in rates in favor of the St. Paul and Minneapolis through lake and rail tariffs.

Since the first Western Pacific fruit train, mentioned in this column last week, was run, the road has maintained a schedule of over 30 miles an hour on fruit trains from Sacramento to Chicago. The first train took 106 hours to run from Sacramento to Chicago.

The Illinois Manufacturers' Association will not file any more general protests against increased rates until the Interstate Commerce Commission has decided on issues now before it. It may do so, however, if some rate is the subject of specific complaints by members.

The Harriman lines have established a new through passenger train service from Tacoma and Puget Sound points to Denver and St. Louis, via the Oregon & Washington, the Oregon Railroad & Navigation Company, the Oregon Short Line, the Union Pacific and the Wabash.

It is believed that the Western Pacific is negotiating with the Toyo Kisen Kaisha for running Japanese steamers from San Francisco in connection with the Western Pacific. This belief is founded on reports that the relationship between the Japanese line and the Pacific Mail Steamship Company is to be broken off.

An oil manufacturing company of Baltimore, Md., has filed with the Interstate Commerce Commission a complaint against the provision of the new freight classification in southern territory to the effect that benzine, gasoline and naphtha must be shipped in metal drums or barrels; the oil company contends that it will not be able to supply such barrels.

The Railroad Commission of Kansas has complained to the Interstate Commerce Commission against the rates charged by the Pullman Company for upper berths. The Kansas commission wants to have the charge for an upper berth less than for a lower berth. The particular complaint is against charges from points in Kansas to Chicago, St. Louis and Fort Worth.

The Interstate Commerce Commission has suspended until November 26 about 125 tariffs, of which 120 were of the Pennsylvania Railroad on general merchandise to southern and western points. Other tariffs of those originally affected August 1 will be suspended until November, some of them being included in those which the railways have already voluntarily suspended.

A meeting of members of the National Industrial Traffic League and the committee appointed last May was held in Chicago on July 29. A committee of seven was appointed to represent the shippers before the Interstate Commerce Commission at the hearing in Chicago on August 22; two attorneys were also selected. Arrangements were made for a fund to defray expenses. The cities represented at the hearing were Minneapolis, St. Louis, St. Joseph, Kansas City, Chicago, Cincinnati, Rockford, Columbus, Indianapolis, Pittsburg, Buffalo and Dayton.

Arrangements are being made for a land show, to be held October 17 to 28, at Pittsburgh, Pa. The object of the exposition is to provide information to the farmer, the home-seeker and investor regarding land openings and developments in all sections of the country, and to show samples of mineral, agricultural, horticultural and botanical products of the soil, and to teach the students and laymen educational facts concerning land reclamation and irrigation. The exhibits will include those of the United States government, state exhibits, boards of trade, chambers of commerce, commercial bodies, land and irrigation companies.

On August 1 the Boston & Maine put in effect new rates for carrying milk in Massachusetts. The state legislature this this year passed a law to the effect that the same rate apply whether milk was carried in carload lots or in single cans. In complying with this law the Boston & Maine is making a rate lower than those in force in New York state, where this "open car" system has been in use. These rates, while lower than those heretofore charged for small shipments, are higher than the former carload rates. In New York there is also a smaller carload rate for cars shipped from a single station, but such a rate cannot be made under the new Massachusetts law.

The Kansas City Live Stock Exchange has filed with the Interstate Commerce Commission charges against 29 roads carrying live stock eastward from Kansas City, declaring that the rates from Kansas City to East St. Louis and eastern points are unreasonable. Up to April 1 of this year a proportionate rate from Kansas City to East St. Louis was in effect on shipments originating east of Kansas City. On that date they were cancelled and now the full local rate is charged from Kansas City to East St. Louis. It is alleged that the defendants have failed to establish through rates from Kansas City to various eastern points, so that Kansas City shippers have to pay the full local rate to East St. Louis and the separate rate from East St. Louis to eastern points. The complainant asks that the old proportionate rates be put into effect by roads west of the Mississippi and that lines both east and west of the Mississippi make through rates to eastern points.

Condition of the Cotton Crop.

The crop reporting board of the Bureau of Statistics of the United States Department of Agriculture estimates that the average condition of the cotton crop on July 25, 1910, was 75.5 per cent. of a normal, as compared with 80.7 on June 25, 1910; 71.9 on July 25, 1909; 83.0 on July 25, 1908; 75.0 on July 25, 1907, and 79.4 the average of the past ten years on July 25.

Comparison of Conditions by States.

States.	July 25, 1910.	June 25, 1910.	July 25. 1909.	July 25. 1908.	10-yr. av.
Virginia	80	81	71	90	81
North Carolina	71	72	71	89	80
South Carolina	70	75	77	84	80
Georgia	70	78	78	85	81
Florida	70	82	84	85	83
Alabama	71	81	68	85	78
Mississippi	71	81	64	86	78
Louisiana	69	77	58	83	78
Texas	82	84	70	82	79
Arkansas	73	77	76	86	80
Tennessee	76	82	80	88	82
Missouri	72	80	85	88	84
Oklahoma	87	88	79	66	81
California	98	95	..	..	..
United States	75.5	80.7	71.9	83.0	79.4

Conference on the New Law.

A three-day conference of legal department officers began at Portsmouth, N. H., on Tuesday of this week. The object of the meeting was to discuss for the guidance of traffic departments the meaning of the revised Interstate Commerce Commission act and also to discuss the question of constitutionality, particularly under the new long and short haul clause. There were 69 delegates in attendance, representing the following companies: The Louisville & Nashville, the Minneapolis, St. Paul & Sault Ste. Marie, the Maine Central, the Bangor & Aroostook, the Missouri Pacific, the Norfolk & Western, the Alabama Great Southern, the Rock Island, the Atlantic Coast Line, the Pennsylvania Railroad, the Southern, the Virginia, the Western of Alabama, the Adams Express Co., the Georgia, Florida & Alabama, the Illinois Central, the Lackawanna, the Boston & Maine, the Carolina, Clinchfield & Ohio, the Union Pacific, the Atlanta, Birmingham & Atlantic, the Iowa Central, the Minneapolis & St. Louis, the Burlington, the Wells-Fargo Express Co., the Seaboard Air Line, the Chesapeake & Ohio, the Mobile & Ohio, the New York Central, the Northern Pacific, the Central of Georgia, the Reading, the Great Northern, the Michigan Ocean Steamship Co., the Erie Railroad and the St. Louis Southwestern.

REVENUES AND EXPENSES OF RAILWAYS.

MONTH OF JUNE, 1910.

Name of road.	Mileage operated at end of period.	Operating revenues: Freight.	Passenger.	Total. inc. misc.	Operating expenses: Maintenance—Way and structures.	Maintenance—Of equipment.	Traffic.	Transportation.	General.	Total.	Net operating revenue (or deficit).	Outside operations, net.	Taxes.	Operating income (or loss).	Increase (or dec.) comp. with last year.
Alabama & Vicksburg	143	$89,247	$39,123	$137,733	$13,978	$26,581	$4,315	$45,302	$5,618	$95,794	$41,939	.....	$4,520	$37,419	$28,607
Atlantic Coast Line	4,491*	1,509,693	493,150	2,194,977	322,633	407,000	40,826	812 733	77,126	1,660,318	534,659	.....	163,960	370,699	116,863
Bangor & Aroostook	600†	165,705	49,754	227,028	40,266	25,522	2,946	68,127	12,563	149,424	77,604	.....	4,412	73,192	6,380
Carolina, Clinchfield & Ohio	237‡	90,177	12,175	106,777	11,452	20,563	4,905	24,255	14 037	75,212	31,565	.....	8,246	23,319	14,397
Charleston & Western Carolina	340	75,201	23,471	105,714	50,944	14,701	3,956	46,249	5,529	121,380	—15,666	.....	7,497	—23,163	—1,225
Chicago & Northwestern	7,629	4,286,875	1,728,654	6,576,811	1,183,744	639,793	96,837	2,350,768	121,603	4,392,745	2,184,066	—$7,007	285,512	1,891,547	468,551
Chicago, St. Paul, Minneapolis & Omaha	1,739	808,655	381,541	1,284,336	227,946	161,708	25,039	436,022	29,735	880,450	403,886	—66	71,382	532,438	69,477
Cincinnati & Muskingum Valley	148	53,175	19,305	77,622	12,434	10,933	1,959	29 229	1,496	55,351	22,271	.....	3,414	18,857	3,202
Cleveland, Akron & Columbus	212	162,775	46,982	225,274	50,304	42,865	3,338	72,129	3,502	172,138	53,136	.....	6,500	46,636	—1,248
Cumberland Valley	162	202,153	50,421	263,389	49,258	38,987	3,489	77.335	10,773	179,842	83,547	292	25,923	57,916	—18,854
Delaware & Hudson Co	843	1,334,827	222,418	1,613,697	152,021	243,801	17 319	588 8 5	38.149	1.040.165	573,532	—727	35,000	537.805	—8.841
Delaware, Lackawanna & Western	950§	2,372,975	621,053	3,194,163	409,940	410,328	3,372	833,967	56,187	1,785,795	1,408,368	—13,737	118,650	1,275,981	79,976
Detroit & Mackinac	369°	76,242	25,483	108,168	19,430	18,884	3,372	33,732	2,695	78,113	30,055	—1,376	8,250	20,420	1,005
Duluth & Iron Range	168	1,261,792	24,528	1,292,880	116,980	67,040	493	1 9 248	8,564	372,325	920,555	4,547	55,683	869,419	161,825
Duluth, Missabe & Northern	293 ||	2,156,921	39,378	2,203,607	119,326	118,051	1,622	225,200	10 931	475,130	1,728,477	13,929	92,955	1,649,452	425,546
El Paso & Southwestern Co	901¶	543,819	93,544	667,705	65,787	78,186	10,121	177,930	22,572	354,596	313,109	—843	34,989	277,272	30,515
Elgin, Joliet & Eastern	781	738,942	4	813,063	104,233	171,694	4,161	266 842	14,515	561,445	251,618	.....	21.115	230 503	—33,005
Evansville & Terre Haute	310	138,804	54,069	211,942	27,771	24,043	5,659	68 824	5,918	132,215	79,727	—767	65,746	26,841	19,680
Grand Rapids & Indiana	587	236,549	137,654	404,826	58,443	86,913	14,409	174,994	15,303	350,062	54,764	—3,175	13,214	255.879	—8,288
Kansas City Southern	827	645,206	132,125	852,950	96,946	101,510	29,222	311,365	28,552	567,595	285 355	.....	24,748	41.304	—14,985
Louisiana & Arkansas	240 ♂	94,948	14,603	113,739	16,305	17,922	2,395	29,246	4,067	69,935	43,804	.....	29,476	14,635	7,505
Louisville, Henderson & St. Louis	200	58,022	31,789	96,419	23,999	12,621	5,428	29,741	2,160	73.949	22,470	426	2,500	182 369	19,494
Maine Central	932	447,580	270,714	775 396	125,951	110,943	10,528	270,740	33,087	548,249	227,147	6,705	8,261	—53,914	—53,914
Midland Valley	324	39,781	29,333	74,376	16,309	18,370	2,146	27,254	4,801	68,880	5,496	1,871	51,483	5,096	—30,992
New Orleans & North Eastern	196	207,616	50,981	278 362	38,505	39,236	11,697	95,438	10,321	195,197	83,165	.....	2.271	74,903	23,548
New York, Philadelphia & Norfolk	112	301,454	32,172	360,220	29,632	46,616	3,459	130,915	12,548	223,170	137,050	.....	8,262	127,636	17,857
Norfolk & Western	1,951¶	2,580,549	330,189	3,001,922	390,548	524,245	59,923	884,447	64,645	1,923,808	1,078,114	—484	9,414	984,831	52,756
Northern Central	471	765,842	184,200	1,016,101	144,728	205,408	16,958	451 667	25,382	844,143	171.958	453	92,800	69,521	—90,679
Pennsylvania Co.	1,416	4,123,538	740,588	5,220,293	650,972	838,496	64,044	1,625,440	88,245	3,267,197	1,953,096	—2,143	102,891	1,762,076	196,221
Pennsylvania R.R. Co.	3,970a	9,775,219	2,752,111	13,424,585	1,855,158	2,693,823	210,749	4,606,518	335,837	9,702,085	3,722,500	—135,582	188,877	879,788	—1,180,064
Philadelphia, Baltimore & Washington	717	883,515	597,212	1,650,410	271,759	301,913	29,176	650,704	40,561	1,294,113	356,297	.....	2,707,130	186,560	—94,875
Pittsburgh, Cincinnati, Chic. & St. L.	1,468	2,211,966	699,146	3,295,745	651,023	656,721	60,655	1,240 583	69,929	2,678,911	616,834	—1,061	149,097	169,737	—300,637
Union Pacific	3,411 △	3,009,362	961,590	4,303,977	485,128	485,834	106,535	1,003.488	96,918	2,177,003	2,126,074	—1,605	144,808	466,675	—181,392
Vandalia	827	587,938	197.108	871,034	108,510	176,626	27,365	337,450	18,236	668.187	202,847	.....	26,172	1,979,661	38,594
Vicksburg, Shreveport & Pacific	171	70,946	36,699	116,873	26,550	16,807	4,101	36,510	4,508	88,476	28,397	.....	6,521	176,675	5,987
West Jersey & Seashore	353	148,585	335,054	514,822	100,166	57,243	15,441	205,658	10,370	388,878	125,944	—6,073	52,663	21,876	—92,658

FISCAL YEAR ENDING JUNE 30, 1910.

Alabama & Vicksburg	143	$1,086,629	$466,681	$1,672,350	$243,645	$266,816	$46,062	$521,102	$63,910	$1,141,535	$530,815	.....	$52,721	$478,094	$191,428
Atlantic Coast Line	4,491*	20,870,397	6,773 332	29,810,268	3,956,325	4,275,967	499,323	9,227,836	850,836	18 810,287	10,999,981	.....	1,208,960	9,791,021	1,709,855
Bangor & Aroostook	600†	2,204,330	638,143	2,990,529	447,229	335,726	33,804	839,878	128,652	1,785,289	1,205,240	.....	20,912	1,184,328	172,968
Carolina, Clinchfield & Ohio	237‡	943,839	137,204	1,116,073	131,913	189,967	60,014	258,705	108,210	748,809	367,264	.....	47,745	319,519	306,308
Charleston & Western Carolina	340	1,174,541	313,497	1,570,432	355,314	214,568	38,051	510,131	47,444	1,165,508	404,924	—$56,941	56,722	348,202	63,184
Chicago & Northwestern	7,629	49,536,839	18,431,017	74,756,684	10,774,338	9,149,217	1,257,756	29,677,354	1,294,954	52,153,619	22,022,065	—647	2,979,512	18,985,612	—1,071,081
Chicago, St. Paul, Minneapolis & Omaha	1,739	9 720,911	4,309,072	15,095,022	1,956,500	1,758,143	285,187	5,553,145	335,504	9,888,479	5,206,543	.....	682,832	4,523,064	472,522
Cincinnati & Muskingum Valley	148	728,240	225,171	1,016,417	189,020	142,479	21,047	352,717	17,826	723,088	293,329	.....	38,278	255,051	100,080
Cleveland, Akron & Columbus	212	1,837,010	508,665	2,508,204	409,915	563,879	33,510	809,342	44,393	1,861,040	647,164	5,696	64,042	583,122	3,679
Cumberland Valley	162	2,242,292	600 835	2 968,159	428,063	342,058	50,686	890,443	77,088	1,788,338	1,179,821	—1,884	70,842	1,114,675	68,012
Delaware & Hudson Co	843	16,077,170	2,893,550	19,936,435	1,302,628	2,689,904	237,743	6,878,832	463,942	11,573,049	8,363,386	280,672	411,468	7,950,034	488,828
Delaware, Lackawanna & Western	930§	26,789,316	6,997,392	36,005,987	3,289,025	4,880,870	675,435	9,771,641	675,798	19,292,769	16,713.218	—1,257	1,516,000	15,477,891	1,192,532
Detroit & Mackinac	369°	864.888	297,516	1,231,243	199,824	196,888	26,552	392,788	33,400	849,452	381,791	—6,756	103,585	276,949	17,902
Duluth & Iron Range	168	9,793,998	369,546	10,289,064	1,355,121	857,629	5,631	1,843,526	152,245	4,214,152	6,074,912	42,414	473,711	5,594,445	1,652,893
Duluth, Missabe & Northern	293 ||	13,452,290	429,899	13,966,426	1,120,584	1,083,091	18,754	1,821,971	140,451	4,184,811	9,781,615	—17,373	650,275	9,173,754	2,857,693
El Paso & Southwestern Co	901¶	6,021,392	1,075,974	7,437,660	979,674	984,047	121,478	2,037,899	271,646	4,394,745	3,042,916	.....	255,600	2,769,943	—74,986
Elgin, Joliet & Eastern	781	8,617,577	164	9,352,325	955,672	1,831,794	61,718	748,698	178,659	5,938,394	3,413,931	—10,208	202,465	3,211,466	771,827
Evansville & Terre Haute	310	1,605,255	628,226	2,471,175	289,067	347,005	50,583	2,921,686	76,457	1,522,945	948,230	—5,591	119,960	818,062	159,703
Grand Rapids & Indiana	587	3,115,364	1,633,794	5,091,087	646,795	884,733	137,531	2,051,282	167,950	3,888,291	1,202,796	.....	269,901	927,304	—12,618
Kansas City Southern	827	7,226,739	1,430,114	9,594,651	1,047,348	1,195,699	319,957	3,346,463	359,117	6,268,584	3,326,067	3,408	327,577	2,998,490	—101,140
Louisiana & Arkansas	240 ♂	1,102,544	170,466	1,322,761	193,891	206,869	22,892	332,648	51,173	807,473	515,288	36,226	27,785	487,503	126,874
Louisville, Henderson & St. Louis	200	705,539	395,905	1,176,868	279,439	109,027	47,172	381,537	32,088	849,263	327,606	20,104	35,761	295,253	57,935
Maine Central	932	5,451,480	2,922,758	8,922,312	1,305,384	1,282,914	94,333	3,021 371	273,284	5,977,287	2,945,025	.....	444,852	2,536,399	328,881
Midland Valley	324	942,393	335,923	1,348,080	223,668	252,351	23,386	382,155	57,959	939,519	408,561	.....	76.814	351,851	270,525
New Orleans & North Eastern	196	2,561,627	618,744	3,443,102	359,592	527,636	112,403	1,143,745	126,847	2,270,223	1.172,879	.....	98,786	1,074,092	230,928
New York, Philadelphia & Norfolk	112	2,756,973	391,639	3,367,648	338,479	554,616	41,660	1,196,463	114,656	2,245,874	1,121,774	—12,441	81,164	1,040,610	217,997
Norfolk & Western	1,951¶	30,037,796	3 924.889	35 063,870	3,752,045	5,951,907	551,806	10,069,726	721 275	21,046,759	14,017,111	7,972	1.060,800	12,943,869	2,366,007
Northern Central	471	9,894,262	2,129,702	12,732,680	1,488,777	2,499,273	167,963	5,563 359	269,624	9,988,996	2,743,685	—42,527	374,683	2,376,973	242,144
Pennsylvania Co.	1,416	41,765,827	7,683,757	53,536,186	6,982,688	8,851,756	842,955	17,246,817	933.864	34,858,079	18,678,107	—1,319,383	1,859,920	16,775,659	3,823,409
Pennsylvania R.R. Co.	3,970a	118,410,381	31 328,406	159,960,806	19,849,260	30,454,073	2,052,210	53,793 865	3 740,838	109,890,246	50,070,560	.....	4,879,918	43,871,258	7,027,436
Philadelphia, Baltimore & Washington	717	9,201,673	7,149,540	18,160,569	2,703,984	3,131,346	303,341	7,137,712	391,367	13,667,750	4,492,819	—10,826	580,048	3,912,771	221,823
Pittsburgh, Cincinnati, Chic. & St. L.	1,468	27,702,416	7,601,046	39,589,164	5,657,201	7,095,203	810,897	13,479,755	735,051	27,778,107	11,811,057	—58,419	1,404,812	10,395,419	1,674,499
Union Pacific	3,411 △	37,225,168	10,912,416	52,628,878	5,735,189	5,723,350	1,312,316	12,832,460	1,181,325	26,784,640	25,844,238	.....	1,774,967	24,010,852	1,194,833
Vandalia	827	6,544,339	2,249,538	9,831,480	1,471,926	1,832,220	297,771	3,617,867	229,808	7,449,592	2,381,888	.....	294,644	2,087,244	241,000
Vicksburg, Shreveport & Pacific	171	843,081	460.612	1,418,312	258,284	253,468	41,971	425 178	53,081	1,031,983	386,329	—10,099	78,290	308,039	50,447
West Jersey & Seashore	353	1,682,475	3,545,817	5,592,786	1,023,284	666,594	161,467	2,278,591	107,220	4,237,106	1,355,680		273,071	1,072,510	—19,408

*Mileage operated on June 30, 1909, 4,476 miles. †Mileage operated on June 30, 1909, 515 miles. ‡Mileage operated on June 30, 1909, 211 miles. §Mileage operated on June 30, 1909, 893 miles. °Mileage operated on June 30, 1909, 348 miles. ||Mileage operated on June 30, 1909, 867 miles. ¶Mileage operated on June 30, 1909, 281 miles. ♂Mileage operated on June 30, 1909, 226 miles. ¶Mileage operated on June 30, 1909, 1,941 miles. aMileage operated on June 30, 1909, 4,017 miles. △Mileage operated on June 30, 1909, 3,310 miles. —Indicates Deficits, Losses and Decreases.

Car Surpluses and Shortages.

Arthur Hale, chairman of the committee on relations between railways of the American Railway Association, in presenting statistical bulletin No. 75-A giving a summary of shortages and surpluses by groups from March 31, 1909, to July 20, 1910, says:

"The improved demand for cars, especially box and refrigerators, resulted in a decrease of 9,230 from the surplus reported two weeks ago, the total for this bulletin being 134,594. The decrease in box cars was 6,211 and in miscellaneous 3,055.

"The coal car surplus was about stationary.

"There was a slight increase in the shortage, but it is still so scattered and so slight as to lack importance.

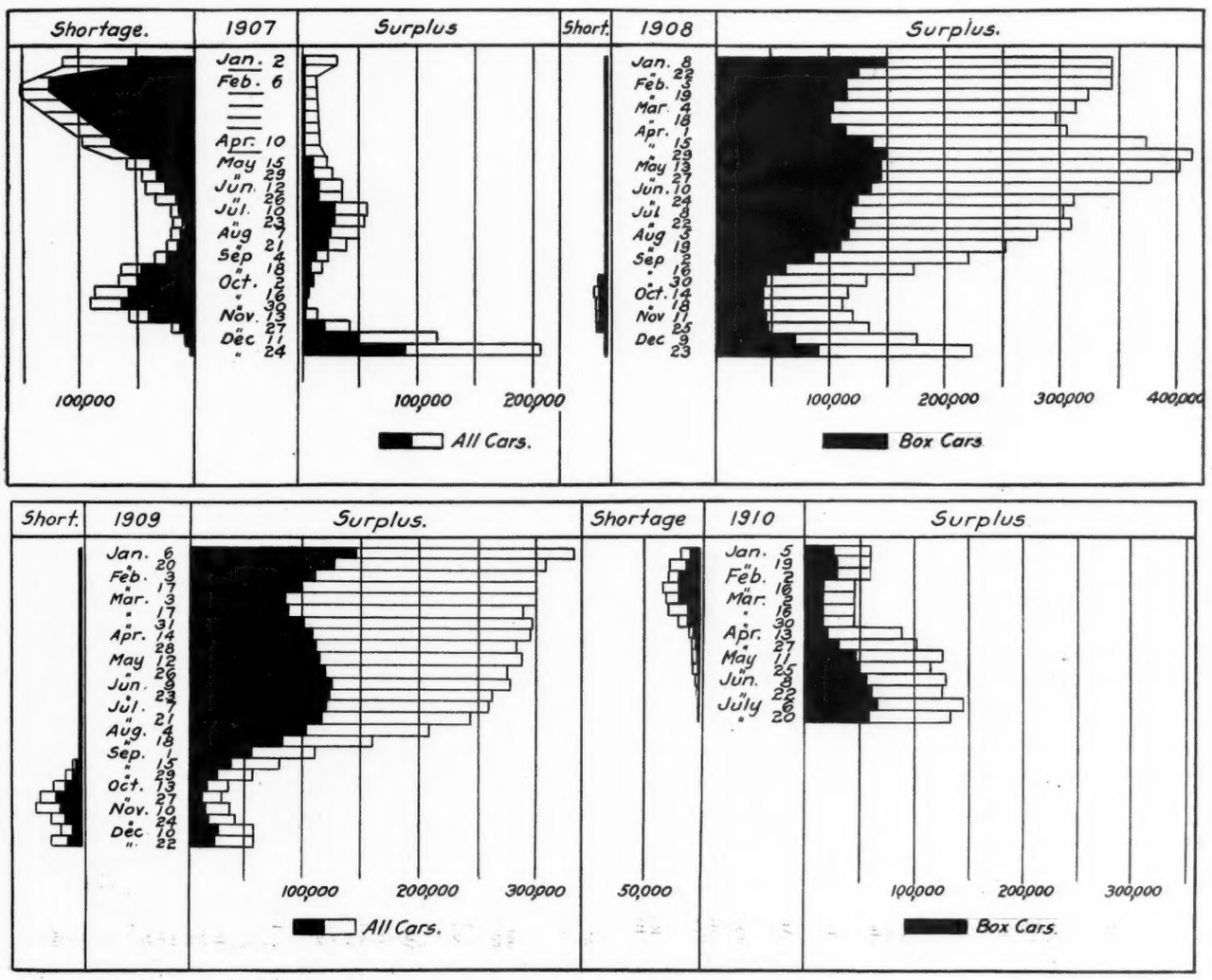
"By a reference to the graphic chart covering the situation for the past three years, it will be noted that this period is the point at which the surplus begins to melt away. In the summer of 1908 the decrease in surplus between July 22 and September 30 was 175,000 cars, and during the same period in 1909 the decrease was 190,000. Last year the reduction in surplus coal cars between July 21 and August 18 was 36,417, only 802 cars less than the present total surplus of this class."

The table gives the surpluses and shortages by groups for the latest period covered by the report, and the charts show the total surpluses and shortages for the years 1907, 1908, 1909 and 1910.

CAR SURPLUSES AND SHORTAGES.

Date.	No. of roads.	Surpluses Box.	Flat.	Coal, gondola and hopper.	Other kinds.	Total.	Shortages Box.	Flat.	Coal, gondola and hopper.	Other kinds.	Total.
Group *1.—July 20, 1910	8	480	396	1,337	75	2,288	35	252	0	8	295
" 2.— " 20, 1910	23	9,722	103	14,150	11,894	35,869	4	12	0	8	24
" 3.— " 20, 1910	23	21,508	606	9,942	2,977	35,033	0	70	0	143	213
" 4.— " 20, 1910	11	2,261	128	459	850	3,698	135	155	0	0	290
" 5.— " 20, 1910	19	2,761	311	1,345	1,517	5,934	15	0	0	0	15
" 6.— " 20, 1910	20	8,366	582	2,540	6,200	17,688	18	3	3	104	128
" 7.— " 20, 1910	3	1,400	117	223	414	2,154	0	0	0	0	0
" 8.— " 20, 1910	11	5,110	221	4,515	3,808	13,654	5	2	4	1	12
" 9.— " 20, 1910	11	2,017	355	120	984	3,476	5	5	0	0	10
" 10.— " 20, 1910	19	3,477	600	2,578	5,742	12,397	86	37	9	0	132
" 11.— " 20, 1910	4	1,765	14	10	614	2,403	0	174	0	0	174
Grand total	152	58,867	3,433	37,219	35,075	134,594	303	710	16	264	1,293

*Group 1 is composed of New England lines; Group 2—New York, New Jersey, Delaware, Maryland, and Eastern Pennsylvania lines; Group 3—Ohio, Indiana, Michigan, and Western Pennsylvania lines; Group 4—West Virginia, Virginia, and North and South Carolina lines; Group 5—Kentucky, Tennessee, Mississippi, Alabama, Georgia and Florida lines; Group 6—Iowa, Illinois, Wisconsin, Minnesota, and North and South Dakota lines; Group 7—Montana, Wyoming and Nebraska lines; Group 8—Kansas, Colorado, Missouri, Arkansas and Oklahoma lines; Group 9—Texas, Louisiana and New Mexico lines; Group 10—Oregon, Idaho, California and Arizona lines; Group 11—Canadian lines.



Car Surpluses and Shortages in 1907, 1908, 1909 and 1910.

Earnings of New York City Railways in the Three Months Ended March 31, 1910.

The total operating revenue of the elevated division of the Interborough Rapid Transit amounted to $3,791,067, and of the subway division to $3,814,203, a total of $7,605,270. This compares with a total operating revenue in the corresponding three months of 1909, for both divisions, of $7,039,526. Operating income, after the deduction of expenses and taxes, amounted to $1,805,977 for the elevated division and $2,528,547 for the subway division, a total of $4,334,524, comparing with a total operating income in the corresponding three months of 1909 of $3,911,803. The Brooklyn Rapid Transit had total operating revenue amounting to $4,866,796 in the three months ended March 31, 1910, as against $4,468,665 in the corresponding three months of 1909. Operating income amounted to $1,383,818 in 1910 and to $1,017,354 in 1909. The Hudson & Manhattan, operating the tubes under the Hudson river, had total operating revenue for the three months amounting to $648,576, as against $211,743 in 1909; and operating income of $562,938 in 1910, as against $202,352 in 1909. The Metropolitan Street Railway system in the three months of 1910 had total operating revenue amounting to $3,440,880, as against $3,317,241 in 1909; and operating income of $582,028, as against $667,444. The Third Avenue system had operating revenue amounting to $1,871,934, as against $1,638,290; and operating income of $566,199 in 1910 and $391,280 in 1909.

INTERSTATE COMMERCE COMMISSION.

Complaint Dismissed.

Quammen & Austad Lumber Co. v. Chicago, Milwaukee & St. Paul et al. Opinion by Commissioner Clements.

No witnesses appeared at the hearing and no evidence was produced. (19 I. C. C., 110.)

Lumber Rate Reduced.

Commercial Club of Omaha v. Chicago & North Western et al. Opinion by Commissioner Clark.

Rates on lumber from Omaha to certain points in Colorado, Kansas and Nebraska found to be unreasonable, and lower rates prescribed. (19 I. C. C., 156.)

Box Shooks Rate Reduced.

Sawyer & Austin Lumber Co. v. St. Louis, Iron Mountain & Southern et al. Opinion by Commissioner Harlan

Any rate on box shooks between the points involved in this proceeding in excess of the current rate on yellow-pine lumber between the same points is unreasonable. (19 I. C. C., 141.)

Unloading Facilities Found Ample.

Reiter, Curtis & Hill v. New York, Susquehanna & Western. Opinion by Commissioner Harlan.

Complaint, demanding refund of demurrage charges that accrued pending negotiations for, and the construction of, private sidings and connections, the work being completed within 30 days after the request for them was made, dismissed as being without merit.

Unloading facilities that are ample to meet the general requirements of a community need not be enlarged by a carrier to meet the special requirements of a single shipper on a given occasion. (19 I. C. C., 296.)

Reparation Denied.

Idaho Lime Co. v. Atchison, Topeka & Santa Fe et al. Opinion by Commissioner Lane.

The charge of misrouting is not sustained. (19 I. C. C., 139.)

W. P. Craig Lumber Co. v. Virginian Railway et al. Opinion by Commissioner Prouty.

Through rate on lumber from Victoria, Va., to Alliance, Ohio, not found unreasonable. (19 I. C. C., 144.)

Billings Chamber of Commerce v. Chicago, Burlington & Quincy. Opinion by Commissioner Clark.

L. C. L. class rates from Billings, Mont., and Sheridan, Wyo., to points in Wyoming on lines of defendant found to be unreasonable, but reparation denied. (19 I. C. C., 71.)

Reparation Awarded.

Menefee Brothers v. Vicksburg, Shreveport & Pacific et al. Opinion by Commissioner Clements.

Charges on carload of shingles from Monroe, La., to Crowell, Tex., found unreasonable. (19 I. C. C., 117.)

William Cameron & Company, Inc., v. Houston, East & West Texas et al. Opinion by Commissioner Prouty.

Rate on shipment of lumber from Davisville, Tex., to Santa Rita, N. Mex., and from Saron, Tex., to Altus, Okla., found unreasonable. (19 I. C. C., 146.)

Gamble-Robinson Commission Co. v. St. Louis & San Francisco et al. Opinion by Chairman Knapp.

Rates collected on shipments of apples from Cedar Gap and Seymour to Minneapolis and St. Paul, to the extent that they exceeded 34 and 34½ cents per 100 lbs., found unreasonable. (19 I. C. C., 114.)

A. H. Millar v. New York Central & Hudson River et al. Opinion by Commissioner Clements.

The fact that the lower rate had been maintained for several years is in the nature of an admission that it was a fair one under the circumstances. *Ocheltree Grain case,* 13 I. C. C., 46, cited and followed. (19 I. C. C., 78.)

Bott Brothers Manufacturing Co. v. Chicago, Burlington & Quincy et al. Opinion by Commissioner Prouty.

Present rates on barrel staves and heading from Malden, Mo., and points in Arkansas, to Alexandria, Mo., found unreasonable, and reasonable rates prescribed for the future. Through route established over certain lines. (19 I. C. C., 136.)

W. W. Rutland and E. L. Rutland, Partners, doing business as The Canadian Valley Grain Co., v. Chicago, Rock Island & Pacific et al. Opinion by Commissioner Harlan.

The record herein brings the complaint within the principle announced in *Kiel Woodenware Co. v. C., M. & St. P.,* 18 I. C. C., 242, where reparation was awarded for the failure of a carrier to post a tariff changing a rate. (19 I. C. C., 108.)

STATE COMMISSIONS.

Wisconsin: Refund Ordered.

J. H. Kaiser Lumber Co. v. Chicago, St. Paul, Minneapolis & Omaha.

Petition alleging exorbitant rates on shipments of logs from Stinson Spur, Wis., to Eau Claire, the rate exacted having been advanced through an error in the published tariff, which error was rectified after the shipments had moved and the rate contended for was re-established.

Wisconsin: Refund Ordered.

Schwoegler & Kelly v. Chicago, Milwaukee & St. Paul and Minneapolis, St. Paul & Sault Ste. Marie.

Petition alleging overcharges on certain shipments of stone from Colfax to Madison, Wis.; also alleging that the rates of 12½ cents per 100 lbs. on stone between the above mentioned points are unreasonably high and praying that a reasonably joint rate be established. The rates complained of are unreasonably high and the establishment of a joint rate of 10 cents is ordered.

Wisconsin: Warehouse Site Furnished.

Roberts Produce Co. v. Chicago, St. Paul, Minneapolis & Omaha.

Petition alleges that respondent company has refused to lease to petitioner a piece of ground on its right of way for an extension of petitioner's warehouse, in violaton of Sec. 1802a of the statutes. Within the meaning of the above mentioned statute public interest and the reasonable convenience and necessities of the petitioner require that respondent furnish the site which petitioner asks at a reasonable rental.

Wisconsin: Station Employee Ordered.

E. G. Brown et al. v. Minneapolis, St. Paul & Sault Ste. Marie.

Petition alleging inadequate station facilities and service at Hillsdale. It is ordered that the respondent provide a reason-

ably adequate waiting room for passengers and a sufficient storage room for freight and baggage; that it employ a competent caretaker, whose duty it shall be to light and heat the station, give out information with reference to trains and other matters, notify consignees of the arrival of trains, and in general do those things which are customarily performed by the agents of railway companies at stations of this character.

Wisconsin: Close Direct Train Construction Ordered.

J. C. Knapp v. Illinois Central, Chicago, Milwaukee & St. Paul.

Petition by a hotel keeper alleging inadequate train service, inadequate maintenance of way, unsanitary condition of certain coaches, and unreasonably poor train connections at certain junction points, as well as excessive irregularity in running schedules of trains.

It is ordered that respondent companies establish close direct train connections between designated trains at Dili Station. A report of the condition of the roadway and coaches is introduced, and the various other questions of service held in abeyance, subject to such further orders as circumstances may indicate to be necessary.

Wisconsin: Maintenance of Highway Bridges.

Town of Rhime v. Chicago, Milwaukee & St. Paul.

Petition praying that the respondent be ordered to make necessary alterations or reconstruct two highway bridges on its right of way. The highway existed prior to the construction of the railway and necessary bridges were maintained. In building the railway in 1871 the natural course of the creek was changed, but in order to avoid expensive litigation the town constructed the necessary new bridges and has since maintained them. It is conceded that the bridges are unsafe for public travel.

The bridges in question form a part of the approaches to the crossings over the railway tracks and it is the duty of the respondent to maintain such bridges so that the same will be safe and convenient for public travel.

Wisconsin: Rate Schedule Approved.

Frank B. L. Fullmer v. Wausau Street Railroad.

The testimony on the re-hearing and the investigations of the commission revealed a situation with respect to respondent's business somewhat different from that which was assumed in the first proceeding. Material changes have taken place in the business. The railway system has been extended. An unusual advance in traffic and revenues has resulted, and the annual rate of profits has greatly increased. The rate of profits shown by respondent's reports was higher than the rate found by the commission, on account of the respondent company's former practice of charging numerous items of operation and maintenance to the construction account. This practice has apparently ceased and the company seems to be endeavoring to comply with the uniform accounts required by statute. A new and simpler schedule of rates has been proposed by respondent and put into effect March 10, 1910. This schedule is approved herein, subject to such changes as may be made hereafter in accordance with law. The order reaffirms the original order with respect to combination or joint tickets, with respect to separate accounts showing the operation of the park and also separate accounts for each class of passenger fares.

COURT NEWS.

Judge Martin, of the United States district court, sitting at Windsor, Vt., on July 27 fined the Montpelier & Wells River $1,000 for discrimination in a shipment of coal.

Judge Hollister, of the United States circuit court at Cincinnati, Ohio, decided in favor of the plaintiff on July 27 in the case of Edwin S. Dickerson v. the Louisville & Nashville. The road, after accepting a shipment, found that the Pittsburgh, Cincinnati, Chicago & St. Louis, the connecting line over which the shipment was to be made, was congested with freight. The shipment was sent by another route, resulting in a higher charge than was originally shown on the bill of lading. The court held that the defendant road could not collect the excess in charges.

Railway Officers.

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

Lewis Neilson, secretary of the Pennsylvania Railroad, has been appointed also secretary of the Northern Central, succeeding Stephen W. White, and secretary of the West Jersey & Sea Shore, succeeding J. M. Harding, deceased.

F. C. Gifford, assistant general freight agent of the Chicago, St. Paul, Minneapolis & Omaha at Minneapolis, Minn., has been elected secretary, treasurer and general manager of the Williamsville, Greenville & St. Louis, with office at Greenville, Mo.

Stephen William White, secretary of the Northern Central Railway and other subsidiary companies of the Pennsylvania System, has been retired under the pension rules, having reached the age limit of 70 years. Mr. White was born in Philadelphia on July 16, 1840, and at the age of 18 was graduated from the Central High School as Bachelor of Arts, and five years later received from the same school the degree of Master of Arts. He entered the service of the Pennsylvania Railroad System in January, 1875, as assistant secretary of the Northern Central, and was elected secretary of that company in September, 1877, which position he has occupied continuously since that time.

Operating Officers.

J. O. Gordon, superintendent of the Chicago Great Western at Des Moines, Iowa, has been appointed also superintendent of the Leavenworth Terminal & Bridge Company.

F. M. Bowman, assistant to the president of the Gulf, Texas & Western at Jermyn, Tex., has been appointed assistant general manager of the Crosbyton & South Plains, a projected line in Texas.

J. L. Orbison, superintendent of telegraph of the Cincinnati, Hamilton & Dayton, has been granted an indefinite leave of absence on account of ill health. Reports heretofore made to him will be made to the general superintendent.

Guy Adams, supervisor of mails of the Chicago, Rock Island & Pacific, the St. Louis & San Francisco and the Evansville & Terre Haute, has been appointed manager of mail traffic of the Chicago, Rock Island & Pacific, with office at Chicago.

W. H. Gunzleman, chief despatcher for the Chicago & Alton at Bloomington, Ill., has been appointed trainmaster of the St. Louis division S. H. A. Henderson, night trainmaster for the Kansas City Southern at Oklahoma City, Okla., succeeds Mr. Gunzleman.

Albert Dabney Shelton, who has been appointed superintendent of the Southern Railway, with office at Greensboro, N. C., was born July 4, 1875, at Chatham, Va. He began railway work in February, 1890, with the Richmond & Danville, and has been in continuous service with that company and its successor, the Southern Railway, up to the present time. During this period he has been consecutively messenger, clerk, operator, agent operator, despatcher, chief despatcher and then trainmaster, which position he held at the time of his recent appointment as superintendent.

Traffic Officers.

W. J. Walker has been appointed a commercial agent of the Timpson & Henderson, with office at Timpson, Tex.

S. P. Sanford has been appointed special traffic agent of the Atchison, Topeka & Santa Fe, with office at Los Angeles, Cal.

R. G. Thompson, district passenger agent of the Wabash at Indianapolis, Ind., has been appointed division passenger agent, with office at Chicago.

W. B. Gibbs has been appointed traveling freight and passenger agent of the Chicago & Alton, the Minneapolis & St. Louis and the Iowa Central, with office at Peoria, Ill.

S. V. Derrah, assistant general freight agent of the Denver & Rio Grande, at Salt Lake City, Utah, has been appointed also assistant general freight agent of the Western Pacific.

The jurisdiction of W. E. Lowes, assistant general passenger agent of the Baltimore & Ohio, with office at Baltimore, Md., has been extended over the Baltimore & Ohio Southwestern.

A. H. Rising, chief clerk in the general freight office of the Southern Pacific at San Francisco, Cal., has been appointed an

assistant general freight agent, with office at San Francisco. E. W. Clapp, district freight and passenger agent at Fresno, Cal., succeeds Mr. Rising.

F. W. Robinson, assistant general freight agent of the Oregon Railroad & Navigation Company and the Southern Pacific at Portland, Ore., has been appointed general freight agent, with office at Portland, succeeding W. E. Coman, resigned, to accept service with another company.

H. C. Burnett, general freight agent of the Lehigh Valley, with office at New York, has been appointed assistant freight traffic manager. F. J. Woulfe, general eastern freight agent, succeeds Mr. Burnett, and C. E. Crane has been appointed general eastern freight agent, with office at New York, succeeding Mr. Woulfe.

J. P. Rogerman, traveling passenger agent of the Baltimore & Ohio Southwestern, at Dallas, Tex., having been promoted to western passenger agent, with office at Kansas City, Mo., W. F. Geisert, traveling passenger agent at St. Louis, Mo., succeeds Mr. Rogerman, with the title southwestern passenger agent. L. G. Paul succeeds Mr. Geisert.

Wm. Fitzgerald, Jr., general freight agent of the Chicago, Cincinnati & Louisville at Chicago, has been appointed assistant general freight agent of the Chesapeake & Ohio of Indiana, with office in Chicago. T. H. Gurney, general passenger agent of the former road at Chicago, has been appointed district passenger agent of the Chesapeake & Ohio of Indiana at Chicago. The jurisdiction of the following officers of the Chesapeake & Ohio has been extended over the Chesapeake & Ohio of Indiana: E. D. Hotchkiss, general freight agent; John D. Potts, general passenger agent; A. P. Gilbert, assistant general freight agent, and C. Lorraine, general baggage agent, all with office at Richmond, Va.

Engineering and Rolling Stock Officers.

O. H. Rehmeyer, road foreman of equipment on the Chicago division of the Chicago, Rock Island & Pacific at Chicago, has been appointed road foreman of equipment of the Iowa Central, with office at Oskaloosa, Iowa, succeeding J. L. Brummell, transferred.

George H. Bussing, superintendent motive power of the Evansville & Terre Haute, at Evansville, Ind., has been appointed superintendent motive power of the Buffalo & Susquehanna Railroad and the Buffalo & Susquehanna Railway, with office at Galeton, Pa.

L. R. Byram, formerly signal supervisor on the Iowa division of the Chicago, Rock Island & Pacific, has been appointed signal supervisor on the Chicago Terminal division of that road. H. B. McCallum has been appointed acting supervisor of the Iowa division at Des Moines.

J. D. Lovell has been appointed supervisor of Division No. 21 of the Pennsylvania Railroad, with office at Tyrone, Pa., succeeding L. S. Seymour, transferred, and R. S. Stewart has been appointed assistant supervisor of Division No. 5½, succeeding W. S. Johns, Jr., promoted.

Peter Smith, assistant road foreman of equipment of the Chicago, Rock Island & Pacific at Chicago, has been appointed road foreman of equipment on the Terminal and Illinois divisions, with office at Chicago, succeeding O. H. Rehmeyer, resigned to accept service elsewhere.

J. L. Brummell, road foreman of equipment of the Iowa Central at Oskaloosa, Iowa, has been appointed road foreman of engines of the Minneapolis & St. Louis, with office at Minneapolis, Minn. He will have jurisdiction over trainmen, enginemen and all roundhouse foremen on the Eastern division.

Thomas O'Leary, master mechanic on the Tucson division of the Southern Pacific at Tucson, Ariz., has been appointed master mechanic at Los Angeles, Cal., succeeding D. P. Kellogg, whose appointment as shop superintendent of the general shops at Los Angeles has been announced in these columns. W. C. Peterson, roundhouse foreman at Yuma, Ariz., succeeds Mr. O'Leary.

Special Officers.

George McGowan, special officer for the Illinois Central at Champaign, Ill., has been appointed to a position in charge of special agency work on the Memphis division, with office at Clarksdale, Miss.

Railway Construction.

New Incorporations, Surveys, Etc.

Aransas Terminal.—An officer writes that a contract has been given to the Bowers' Southern Dredging Co., Galveston, Tex., for work on the line under construction from Aransas Pass, Tex., southeasterly along the channel of the Aransas Pass & Dock Co. to deepwater, on the east side of Harbor Island. From the shore at Aransas Pass the line will pass over a solid fill, 9,000 ft. long, thence across Stedman Island, about 700 ft. It will then cross the old Corpus Christi channel on a 500-ft. trestle, thence over a fill about 1.5 miles long, crossing an arm of Corpus Christi bay to Harbor Island, continuing on Harbor Island to the east side of the island. C. E. Corrigan, chief engineer, Box 183, Aransas Pass. (April 15, p. 1014.)

Arizona, Mexico & Gulf of California.—Plans for the water terminal at Port Lobos, Mex., have been completed by the Robbins-Ripley Co., engineers and contractors, New York. The terminal consists of a pier 500 ft. long, to be partially shedded and so located that there will be sufficient depth of water for the largest ocean vessels, with an approach 2,500 ft. long leading in to the shore. As the waters of the Gulf of California are infested with the teredo, some provision had to be made to procure a permanent type of piling, which resulted in the adoption of the Ripley combination piling throughout the entire structure, this type of piling having been successfully used in a large dock built at Port au Prince, Hayti. It is expected that the construction work on the pier and approach will be started at once. (July 22, p. 173.)

Baltimore & Ohio.—R. J. Malone, railway contractor, who has a contract for work on the line between McCool, Ind., and Wellsboro, including about 8,000 cu. yds. of grading, to be completed by November 1, has sublet 10 concrete bridges to J. J. O'Heron & Co., Chicago.

Baton Rouge, Hammond & Eastern.—Improvements, including ballasting and banking, are being carried out on this line from Baton Rouge, La., east to Hammond, 44 miles. This work was made necessary on account of the increased traffic.

British Columbia & Alaska.—According to press reports from Seattle, Wash., plans are being made to build from Vancouver, B. C., north via Litton and Fort George, to the northern boundary of British Columbia. The company has under consideration the question of building a line via Telegraph Creek to Skagway, Alaska. J. Wolkenstein, president, Seattle. H. G. Villard is also interested.

Carlton & Coast.—An officer writes that this company is building a line from Carlton, Ore., northwest to Fairdale. The work, which includes two combination Howe truss bridges, is being done by the company forces. Chas. E. Ladd, president; M. L. Johnson, chief engineer, Concord building, Portland, Ore.

Charlotte Harbor & Northern Railway.—An officer writes that the extension from Arcadia, Fla., north has been completed for 44 miles to Pierce, and is now in operation. The company is building with its own forces an additional three and a half miles, which will give the company a total of 100.5 miles of line. The extension will be continued further north to Plant City, in all 112 miles. (April 9, p. 820.)

Concho, San Saba & Llano Valley.—Press reports from Galveston, Tex., say that this line was opened for operation on August 1. (See Atchison, Topeka & Santa Fe, Dec. 17, p. 1213.)

Copper River & Northwestern.—Press reports indicate that the four-span bridge across the Copper river between Miles and Childs glaciers in Alaska has been completed, establishing train service to Mile 116. The new town of Chiltina at Mile 138 will probably be reached by September 1. (June 10, p. 1436.)

Great Northern.—Plans are said to have been submitted to the Washington Railroad Commission for construction work on a part of the main line west of Wellington, Wash., in the Cascades, including a new tunnel at a lower level than the present tunnel. The work now under way by this company at Wellington and west of that place is expected to be finished by December 1, and will cost about $1,500,000.

HOUSTON & TEXAS CENTRAL.—See Southern Pacific.

JAMES RIVER VALLEY & NORTHWESTERN.—According to press reports, the line from Blunt, S. Dak., on the Chicago & North Western, north to Gettysburg, also on the C. & N. W., has been opened to operation. (July 23, 1909, p. 168.)

LARAMIE, HAHN'S PEAK & PACIFIC.—An officer is quoted as saying that this road, which is now in operation from Laramie, Wyo., west to Centennial, thence south to Foxpark, 54.6 miles, is to be extended southwest to Steamboat Springs, Colo. It is expected to have the work finished during 1910. (April 15, p. 1021.)

MISSOURI, OKLAHOMA & GULF RAILROAD.—An Oklahoma charter has been granted for a company of this name, capitalized at $2,000,000, to build lines of railway and to acquire any already built, in the state of Oklahoma or elsewhere. The company is also given authority to bridge the Red river at a point in Bryan county. The Missouri, Oklahoma & Gulf Railway was chartered under the laws of Oklahoma territory in October, 1895, to build a north and south line from the Kansas state line to Red river. (July 22, p. 174.)

RED RIVER & GULF.—This is the new name of the Red River Railway, which has recently filed amended articles of incorporation with the Secretary of State of Oklahoma, changing its name. It proposes to build from Oklahoma City south to the Red river near Grady, Jefferson county, 150 miles, and from Oklahoma City, southwest to the Red river in Jackson county, 125 miles. The directors include: Joseph Moore, George Robertson, F. J. Hawk, S. C. Hawk, Oklahoma City, and J. W. Hooker, Purcell.

ST. LOUIS, BROWNSVILLE & MEXICO.—An officer writes that work on the Tres Palacios branch to College Port, Tex., in Matagorda county, is nearing completion. About 10 miles of this branch was built some two years ago, and with the extension it will have a total length of about 17 miles. The line is being laid with 65-lb. rail taken from the main line. The company is at present laying 17 miles of 80-lb. rail on the main line, and will probably lay an additional 17 miles this fall. (April 1, p. 918.)

SAN PEDRO, LOS ANGELES & SALT LAKE.—An officer writes that the report that a branch is to be built from the main line west to Ely, Nev., is premature. Nothing definite has yet been determined.

SAVANNAH, AUGUSTA & NORTHERN.—An officer writes that a grading contract has been given to C. M. Purdue, Rocky Ford, Ga., for work on an extension of 15 miles. The bridge work and track laying are to be carried out by the company's men. The plans call for a line from Statesboro, Ga., northwest via Colfax, Bland, Portal, Aaron, Miley and Garfield to a point beyond Louisville, of which the first 25 miles is now in operation. Work on the extension will be light. Maximum grade will be 1.0 per cent. and maximum curvature 4 degs. Location work will be started this year for a further extension. (March 25, p. 850.)

SOUTHERN PACIFIC.—According to press reports, the San Joaquin division has been extended from Haiwee, Cal., to Olancha, nine miles. (Feb. 11, p. 329.)

Plans are said to be under consideration for extending the Houston & Texas Central from Llano, Tex., west about 75 miles to a connection with the line of the St. Louis & San Francisco under construction at Menardville. The line may eventually be extended southwest to the Southern Pacific at Sanderson, in Terrell county, in all about 250 miles.

UNION PACIFIC.—According to press reports, work on the Denver-Fort Morgan line in Colorado is to be started in about two weeks. (March 25, p. 850.)

WISCONSIN ROADS.—The Cincinnati Construction Co., which proposes to build a line from Janesville, Wis., northwest to Madison, has filed a certified check for $5,000 at Edgerton. Plans are being made to begin building operations within 30 days.

Plans are being formulated for building a line from Viroqua, Wis., southwest to West Prairie, 14 miles. It is said that this work will cost $250,000.

Railway Financial News.

BALTIMORE & OHIO CHICAGO TERMINAL.—J. N. Faithorn, receiver of the Chicago Terminal Transfer, the predecessor of this company, has filed his final report in the United States circuit court. His receipts were $13,929,127, and expenditures, $13,914,231.

BARTLETT-FLORENCE.—S. W. Brown, Georgetown, Tex., has been appointed receiver of this road, which runs from Bartlett to Jarrell, 12 miles.

BUFFALO & SUSQUEHANNA RAILROAD.—The preferred stockholders' committee, J. N. Wallace, chairman, says that a majority of the preferred stock has been deposited under the agreement of May 12, 1910, and the time for the deposit of preferred stock with the Central Trust Co., New York, has been extended to August 8, 1910.

BUFFALO & SUSQUEHANNA RAILWAY.—William Salomon & Co., New York, are offering at par $383,000 6 per cent. receiver's certificates of July 1, 1910-July 1, 1911. This is part of an authorized issue of $750,000 receiver's certificates, having a prior lien on all of the property in the hands of the receiver of the Buffalo & Susquehanna Railway, which company leases the property of the Buffalo & Susquehanna Railroad.

CANADIAN NORTHERN.—President Mackenzie is quoted as saying: "We want the Intercolonial, which will be the natural extension of the Canadian Northern from Montreal to the Atlantic seaboard."

CANADIAN NORTHERN ONTARIO.—The Ontario & Ottawa, a Canadian Northern Ontario subsidiary, recently incorporated to build connecting lines in Ontario, is to apply to the Canadian Railway Commission for permission to buy the following roads: Brockville, Westport & Northwestern, Brockville, Ont., to Westport, 45 miles; Irondale, Bancroft & Ottawa, Grand Trunk Junction to Bancroft, 48 miles; Marmora Railway & Mining Co., junction with Central Ontario Railway to iron mines, 10 miles, and Central Ontario Railway, Picton to Maynooth, 132 miles, and branch to Coe Hill iron mines, eight miles.

CHICAGO, KALAMAZOO & MICHIGAN.—See Grand Trunk.

CHICAGO, ROCK ISLAND & PACIFIC.—See editorial note in this issue.

DENVER & RIO GRANDE.—See editorial note in this issue.

GRAND TRUNK.—It is understood that negotiations are under way for a lease of 11 miles of the Chicago, Kalamazoo & Michigan, giving the Grand Trunk entrance into Kalamazoo, Mich., via Pavilion.

GRAND TRUNK PACIFIC.—This company is offering for subscription in London £2,000,000 ($10,000,000) first mortgage 3 per cent. bonds at 82½.

INTERCOLONIAL.—See Canadian Northern.

LEHIGH VALLEY.—See editorial note in this issue.

MISSOURI PACIFIC.—See editorial note in this issue.

NATIONAL OF MEXICO.—See Southern Pacific.

ONTARIO & OTTAWA.—See Canadian Northern Ontario.

RIO GRANDE RAILROAD.—This property was sold under foreclosure on July 26 to William E. Guy, of St. Louis, Mo., who is said to be acting for the St. Louis & San Francisco. The road runs from Brownsville, Tex., to Point Isabel, 23 miles, and has $44,000 bonds and $225,000 stock outstanding.

ST. LOUIS & SAN FRANCISCO.—See Rio Grande Railroad.

SOUTHERN PACIFIC.—An agreement has been made for trackage rights over the National of Mexico tracks from Orendain, on the Southern Pacific of Mexico, to Guadalajara, and for the use of the National of Mexico's terminal facilities at Guadalajara.

THIRD AVENUE (NEW YORK).—The Public Service Commission has disapproved the reorganization plan submitted by the bondholders, but a final decision is withheld until the applicants can amend their petition and submit evidence on certain matters. (Dec. 10, '09, p. 1169.)

WABASH.—See editorial note in this issue.

WESTERN PACIFIC.—See editorial note in this issue.

Supply Trade Section.

The Isthmian Canal Commission will receive bids until August 29 for deformed steel bars. (Cir. No. 599.)

George W. Hutton, age 62 years, a director of McGuire-Cummings Manufacturing Co., Chicago, died July 27.

The Canadian General Development Company has ordered one class 45-16-2½ Atlantic steam shovel from the Atlantic Equipment Co., New York.

The North American Railway Specialties Co., Chicago, has been incorporated with a capital stock of $50,000. The incorporators are: S. J. Cotsworth, S. P. McGough and E. M. Fry.

The Strohmeyer Brake Shoe Co., Camden, N. J., has recently been incorporated with a capital stock of $100,000. The incorporators are Julius Strohmeyer, C. A. Harris, Jr., H. S. Peddle and William W. Morton.

The Robbins-Ripley Co., engineers and contractors, New York, have completed plans for a large water terminal at Port Lobos, Mex., for the Arizona, Mexico & Gulf of California. See this company under Railway Construction.

E. R. Hibbard, president of the Grip Nut Company, Chicago, accompanied by his wife and 16-year-old son, left Chicago July 28 on a 10 weeks' trip to the Orient. Mr. Hibbard says "there are still a few heathen not using grip nuts."

The Railway Brake & Shoe Co., Moundsville, W. Va., will establish a plant at Moundsville, W. Va., for the manufacture of brake shoes. The building will be 80 x 300 ft. and will cost $10,000. The company will install about $20,000 worth of equipment.

C. W. Allen, vice-president of the L. J. Bordo Co., Philadelphia, Pa., will sail for Europe August 3 on the S. S. Caronia of the Cunard Line, for a six weeks' trip, combining business and pleasure. Mr. Allen will be accompanied by his son, George K. Allen.

The Bucyrus Company, South Milwaukee, Wis., has secured all the rights to manufacture and sell the Heyworth-Newman drag line excavator, formerly held by James O. Heyworth, of Chicago. A complete line of these excavators will be developed and placed on the market.

The Blue Island Rolling Mill & Car Co., Blue Island, Ill., has leased its property to the Chicago, Rock Island & Pacific. By its terms the Rock Island has rented the property for $2,500 a month, but has the right to purchase the property prior to October 31, 1910, for $150,000.

At a meeting of the directors of the Westinghouse Electric & Mfg. Co., Pittsburgh, Pa., last week, Edwin F. Atkins, of Boston, Mass., was elected president, succeeding George Westinghouse, who remains on the board of directors. It is announced that Mr. Atkins will hold the office only temporarily.

The Shepherd Automatic Switch Co., Montgomery, Ala., has been organized with a capital stock of $700,000 to manufacture railway switches opened or locked from the locomotive or an electric railway car. M. L. Shepherd, president; Nathan Lohman, vice-president; G. E. Kyser, secretary; T. E. Lovejoy, treasurer.

The American Rolled Gold Leaf Company, Providence, R. I., has engaged the services of Charles H. Bowers and T. J. Lawler. Mr. Bowers was, for about 10 years, with the W. H. Coe Mfg. Co., Providence, R. I., and in his new capacity will be railway sales manager. Mr. Lawler was, for about eight years, with Berry Bros., Detroit, Mich. He entered upon his new duties on June 1.

The Frost-Johnson Lumber Company, St. Louis, Mo., bidding as August John Molt, submitted the lowest proposal, on July 27, to the Mississippi River Commission for the delivery of piling during the fiscal year ending June 30, 1911. This piling will be used in the improvement of the Mississippi river between Cairo, Ill., and St. Louis. The quantity will aggregate approximately 15,000 sticks, averaging 50 ft. long. This is equal to 1,000 carloads of rough lumber.

J. D. Keen, formerly chairman of the Order of Railway Conductors, L. & N. system, has been appointed general manager of the Pneumatic Jack Company, Louisville, Ky. This company was incorporated last year with a capital stock of $150,000 for the purpose of manufacturing and selling pneumatic railway jacks, and plans are now being made for the erection of a factory. The officers are as follows: A. T. MacDonald, president; R. S. Brown, vice-president; J. D. Keen, general manager; A. P. Barnard, treasurer; L. J. Dittmar, secretary.

The American Spark Arrester Company, Indianapolis, Ind., whose incorporation was noted in the *Railway Age Gazette* of July 29, has elected the following officers: President, James W. Sale, Bluffton, Ind.; vice-president, H. N. Knight, Oklahoma City, Okla.; secretary, C. A. McCotter, Indianapolis, Ind.; treasurer, C. F. Remy, Indianapolis, Ind. A series of tests of the spark arrester owned by the company has been made at Purdue University, and additional road tests will be made in the near future. It is expected that its adoption will make possible the successful burning of lignite for locomotive fuel.

June sales of the Western Electric Company, New York, were at a rate which verifies earlier prediction of a $61,000,000 year. Comparisons of 1910's estimated gross sales with preceding years are as follows:

	Gross Sales.	Increase.
1910	*$61,000,000	$15,000,000
1909	46,000,000	13,000,000
1908	32,000,000	**20,000,000
1907	53,000,000	**16,000,000
1906	69,000,000	25,000,000
1905	44,000,000	12,000,000
1904	32,000,000	2,000,000
1903	30,000,000	1,000,000
1902	29,000,000	5,000,000
1901	24,000,000	.....
1900	24,000,000	.....

*Estimated. **Decrease.

RAILWAY STRUCTURES.

AVONDALE, ALA.—The Alabama Great Southern will build a brick freight depot to cost about $15,000.

CHATTANOOGA, TENN.—It is said the Queen & Crescent will build a new drawbridge over the Tennessee river about three miles north of Chattanooga.

CLEVELAND, OHIO.—The Terminal Warehouse Co., Cleveland, Ohio, will build a freight station in Cleveland.

DULUTH, MINN.—The Duluth & Iron Range will build a new passenger station. It will be two stories high and cost about $7,000.

JAMAICA, N. Y.—Excavation work has been started for the foundations of the new station and office building for the Long Island Railroad at Jamaica. It is the intention of the company to put up at the present time a two-story building capable of extension at a later time to eight-stories. (March 4, p. 464.)

KANSAS CITY, MO.—The Chicago, Rock Island & Pacific will build a fireproof freight house 40 ft. x 545 ft., of which 40 x 200 ft. is two stories high, second story to be used for the offices of all the freight houses. The total cost is to be $85,000. Geo. B. Swift & Co., Chicago, has been given a contract for the work.

The Missouri Pacific will enlarge its present plant at East Bottoms for the purpose of increasing its capacity. The appropriation for improvements is $100,000 for the locomotive department and $120,000 for the car department. The entire plans have not been perfected.

LOUISVILLE, KY.—The Louisville & Jefferson Bridge Company is building a structure which will be used as a direct entrance into their yards for Chesapeake & Ohio trains using the Louisville & Nashville tracks between Lexington and Louisville. It will also be used for the interchange of switching and through business between the Chesapeake & Ohio and Louisville &

Nashville. It will be approximately 2,800 ft. long. This structure was authorized by an ordinance passed in November, 1906. The company will build another structure which will be an extension of the present double-track street car viaduct which leaves their bridge at Fulton street. It will be about 1,600 ft. long. Right-of-way for this structure has been secured and the company has asked the city authorities for an ordinance, and proposes to start work at once. Both structures call for about 2,600 tons of steel.

MCCOOL, IND.—See Baltimore & Ohio under Railway Construction.

MATTOON, ILL.—The Big Four is said to be planning to build a new, large roundhouse.

OMAHA, NEB.—The Union Pacific has given the contract for its new headquarters building to James Stewart & Co.

OTTUMWA, ILL.—It is said the Chicago & Alton will build a new roundhouse.

PARIS, TEXAS.—The St. Louis & San Francisco has given a contract for the building of a union depot to cost about $30,000.

PEORIA, ILL.—The Galesburg & Peoria has secured an option for a half block of land on which they plan to build a freight depot and sub-passenger station.

PETROLEUM CENTER, PA.—The Pennsylvania will build a two-span, through truss bridge over Oil Creek. The bridge will have two spans, 140 ft. center to center of pins, will be 30 ft. high and will require about 320 tons of steel. The total estimated cost is $11,000. Contract has been given to the American Bridge Company for fabricating the superstructure.

PORT ARTHUR, ONT.—The Canadian Northern has given a contract, it is said, to S. Brown, Winnipeg, Man., for building a roundhouse at Port Arthur.

PORTLAND, ORE.—It is officially reported that the Great Northern will spend about $1,000,000 in the construction of concrete and frame snowslides in bringing the Cascade division of the road to meet the requirements of the Interstate Commerce Commission.

RUSSELL, KY.—It is reported that the Chesapeake & Ohio will build a roundhouse.

SACRAMENTO, CAL.—An officer of the Northern Electric Railway writes that bids will be received by General Manager A. D. Schindler, San Francisco, Cal., for the steel drawbridge on concrete piers, to be built over the Sacramento river at Sacramento. The bridge is to have two fixed spans, each 125 ft. long, and a draw span 400 ft. over all. The cost of the work will be $400,000. (July 8, p. 1071.)

SALT LAKE CITY, UTAH.—The new terminal station of the Denver & Rio Grande and Western Pacific will be opened for business on August 15.

SAN BERNARDINO, CAL.—The Atchison, Topeka & Santa Fe has awarded the contract for the building of the new machine shops. The estimated cost is about $130,000.

SEATTLE, WASH.—It is said the Grand Trunk Pacific Steamship Co. will build a three-story warehouse to cost about $175,000 in connection with its new dock now under construction.

SCRANTON, PA.—The Scranton Railway Co. will build a $50,000 office building on Linden street in Scranton.

SILVER GROVE, KY.—The Chesapeake & Ohio is building a roundhouse and blacksmith shop.

TORONTO, ONT.—Bids will be received by registered post only up to September 6, by G. R. Geary, chairman of the Board of Control, for the construction of a steel viaduct on Queens street in Toronto. The structure is to be built over the river Don, and the roadways on each side and over the tracks of the Canadian Pacific, Canadian Northern and the Grand Trunk.

YOUNGSTOWN, OHIO.—Press reports indicate that the Pittsburgh & Lake Erie will build a new station on the site of the old Lake Shore & Michigan Southern station.

YREKA, CAL.—The Yreka Railroad will build a new depot.

Late News.

The items in this column were received after the classified departments were closed.

It is said that the Elgin, Joliet & Eastern will expend $50,000 in improving its shops at Joliet, Ill.

Michigan railways are said to be organizing a private tax commission to appraise their property for their defense against increase of taxation.

John V. Sevin has been appointed westbound contracting agent of the Traders' Despatch, with office at Pittsburgh, Pa., where he will report to J. J. Lynch, agent.

Washington despatches say that the Interstate Commerce Commission will look into the rates, regulations and practices of express companies when it convenes in the middle of September.

John A. Gill has been appointed a traveling freight and passenger agent of the Southern Pacific, with office at Reno, Nev. He will work in conjunction with A. H. Pett, traveling freight and passenger agent.

W. D. Burr, chief of the tariff bureau of the Chicago, St. Paul, Minneapolis & Omaha at St. Paul, Minn., has been appointed district freight and passenger agent, with office at Duluth, Minn., succeeding A. M. Fenton, promoted.

The Canadian Northern steamfitters, who have been on strike for five weeks, have accepted the company's offer of a five cents an hour increase and increased pay for overtime. The company has declined to negotiate with the striking carmen.

President W. E. Corey, of the United States Steel Corporation, has issued a statement to the effect that the constituent companies of the Corporation have not reduced prices of steel products, nor do they contemplate a reduction. This statement followed reports from Chicago that a cut in prices had been decided upon.

The New York, Westchester & Boston has applied to the Public Service Commission, Second district, for authority to issue $5,000,000 par value 50-year 5 per cent. first mortgage gold bonds, the proceeds of which are to be used for general expenses of right of way and construction of the branch line extending from Mount Vernon, N. Y., to White Plains.

The Chicago, Terre Haute & Bedford will probably be the name under which the Chicago Southern and the Southern Indiana will be reorganized. The total cash requirements to pay off receivers' certificates, bond interest and other claims amounts to $2,339,157, which will be met by a sale of $2,500,000 refunding bonds provided for in the reorganization plan. Holders not yet assenting are given until Sept. 1 to deposit their securities.

About 50 per cent. of the Grand Trunk conductors, trainmen and yardmen have been taken back. In the end, it is said, there will be enough positions for the men taken on during the strike and also the old employees. None of the new men will be discharged, however, and between 20 and 30 per cent. of the strikers will not receive immediate employment. The agreement which ended the strike (see page 255) does not say whether or not the strikers regain their pension rights.

New tariffs have been filed by the St. Louis & San Francisco and the Kansas City Southern, to take effect September 11, which will do away with tap line drawbacks. It is understood that the other roads will act accordingly, and that hereafter no reduction or drawback will be given to industrial concerns which own or operate a tap line. In the case of the Star Grain & Lumber Co. the commission had decided that the tap line practice was unjust and discriminatory, and ordered the practice stopped.

F. P. Zimmerman, traveling freight agent of the Cleveland, Cincinnati, Chicago & St. Louis, at St. Louis, Mo., has been appointed commercial agent of the New York Central lines, with office at East St. Louis, Ill. W. W. Baum, contracting freight agent at Kansas City, Mo., succeeds Mr. Zimmerman, and Harry C. Shaw succeeds Mr. Baum. M. A. Greding has also been appointed a traveling freight agent at St. Louis, and L. P. Hickman has been appointed a contracting freight agent, with office at St. Louis.

Equipment and Supplies.

LOCOMOTIVE BUILDING.

The Mobile & Ohio is in the market for four consolidation locomotives.

The Illinois Central has ordered 35 consolidation locomotives from the Baldwin Locomotive Works.

The Chicago Southern has ordered five consolidation locomotives from the American Locomotive Co.

The Southern Indiana has ordered five consolidation locomotives from the American Locomotive Company.

The Terminal Railroad Association of St. Louis has ordered 10 switch engines from the American Locomotive Co.

The St. Paul & Des Moines has ordered two consolidation locomotives from the Lima Locomotive & Machine Co.

The Maine Central has ordered two Pacific type, four consolidation and four switch engines from the American Locomotive Co.

The Canadian Pacific will build five Mallet locomotives at its Angus shops, similar to the experimental locomotive which was placed in service last winter.

The Michigan Central has ordered 8 consolidation, 8 Pacific and 5 0-6-0 switching locomotives from the Montreal Locomotive Works for September and October delivery.

The Pittsburgh, Shawmut & Northern, reported in the *Railway Age Gazette* of July 15 as being in the market for two locomotives, has ordered two consolidation locomotives from the Baldwin Locomotive Works.

The Baltimore & Ohio, reported in the *Railway Age Gazette* of July 8 as being in the market for 30 Mallet locomotives, has ordered five 0-8-8-0-C type locomotives from the American Locomotive Co. There are 25 Mallets remaining on inquiry.

CAR BUILDING.

The St. Louis & San Francisco has ordered from the American Car & Foundry Co. 500 box cars in addition to the 500 stock cars and 250 tank cars as reported in the *Railway Age Gazette* of July 29.

MACHINERY AND TOOLS.

The Chicago, Rock Island & Pacific has ordered about $20,000 worth of tools.

The New York Central Lines have ordered machinery at a cost of $30,000.

The Delaware, Lackawanna & Western has ordered three cranes from Manning, Maxwell & Moore.

The Vulcan Iron Works has ordered about $12,000 worth of machinery for its plant at Wilkesbarre, Pa.

The Transcontinental Railway has ordered a number of cranes from the Whiting Foundry & Equipment Co., Harvey, Ill.

The Lake Shore & Michigan Southern has ordered a number of tools for its shops in Elkhart, Ind. The road is also in the market for about 15 cranes.

IRON AND STEEL.

The Missouri Pacific has ordered 1,000 tons of structural steel for the Sedalia, Mo., shops.

The Western Pacific has ordered 630 tons of cast iron bases from the American Bridge Company.

The Mexican Central is said to be in the market for 20,000 tons of steel rails of standard sections.

The Union Pacific has ordered 2,500 tons of structural steel for its headquarters building at Omaha, Neb.

The Missouri, Kansas & Texas has ordered 300 tons of cast iron bases for its freight house in St. Louis, Mo.

The New York Central is figuring on 10,000 tons of structural steel for the New York terminal improvements.

The Oregon Railway & Navigation Co. will build a bridge at Portland, Ore., which will require about 7,000 tons of structural steel.

General Conditions in Steel.—The most important feature of the steel situation is that specifications for finished products are being received to an extent which permits the finishing mills to operate at from 75 to 85 per cent. of capacity, notwithstanding the fact that new business is only at about 60 per cent. of capacity. The unfilled tonnage on the books is, of course, supplying the difference. The steel interests in Chicago are reported as expecting a substantial increase in business in the latter part of the year. In structural material, there is reported a good volume of business for this season.

SIGNALING.

The Lake Shore & Michigan Southern put in service about August 1 three new three-arm upper quadrant three-position interlocking signals at the Polk street interlocking plant, Chicago. These signals replace three two-arm lower quadrant signals.

The Chicago, Rock Island & Pacific has nearly completed renewing the pole line between Chicago and Rock Island, on the Illinois division. This work involves new telegraph poles throughout for the accommodation of telegraph, telephone and signal wiring.

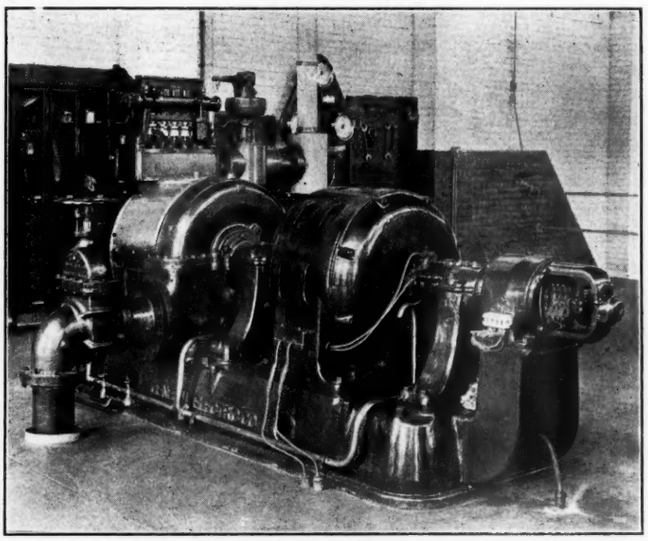
Locomotives for the Prussian State Railways.

Of 900 locomotives to be supplied the Prussian State Raildays during the financial year of 1910 not less than 397, or 44.1 per cent., are to be fitted with the Schmidt superheater. The new orders comprise the following: 64 4-4-0 coupled compound express locomotives, with tenders of 21.5 cubic meters water capacity; 127 4-4-0 coupled superheater express locomotives with similar tenders. Of these engines two are to be supplied with continuous current generators on the Stumpf system, and one of these two is to be shown at the forthcoming Brussels Exhibition; 82 4-6-0 coupled superheater express engines, also with tenders of 21.5 cubic meters water capacity. Two of these engines are to be four-cylinder simple locomotives with driving wheels of 6 ft. 5 in., and one of them will also be exhibited at Brussels; 28 2-6-0 coupled passenger tank engines, with Krauss bogie; 60 2-6-0 coupled superheater passenger tanks, with Krauss bogie; 66 2-6-0 compound freight engines, with Adams' axle, and tenders of 12 cubic meters water capacity; 69 0-8-0 coupled compound freight engines, with similar tenders; 91 0-8-0 coupled freight engines with a heating surface of 2,152.86 sq. ft. and tenders of 12 cubic meters water capacity, one of these engines being destined for exhibition at Brussels; 71 0-8-0 coupled superheater freight engines, of which one, with continuous current generator, is also to be sent to Brussels, with tenders of 12 cubic meters water capacity; 31 0-10-0 coupled superheater freight engines, of which one goes to Brussels, with similar tenders; 149 0-6-0 coupled freight tank engines, with Krauss bogie; 35 0-8-0 coupled freight tank engines; 25 0-10-0 coupled superheater freight tank engines; one 4-4-2 coupled four-cylinder compound express engine of the new Hanover type, having Lertz distribution, and a tender of 31.4 cubic meters water capacity, and one 4-6-0 superheater passenger tank engine. Both these two last named locomotives will also be shown at Brussels, so that there will be exhibited there in all seven engines belonging to the Prussian State Railways, while at least a similar number are expected to be shown by other German railway administrations or locomotive builders.

Shop Equipment.

Electrification of Chesapeake & Ohio Shops; Huntington, W. Va.

The Chesapeake & Ohio shops at Huntington, W. Va., which have been operated from line shafting, driven by reciprocating engines, are now electrically driven. There were four independent power stations equipped with locomotive boilers and reciprocating engines belted to line shafts in the different shops,



100-K. W. Curtis Turbine; C. & O. Shops.

and also to one TH arc machine which supplied power to a few open arc lamps about the shops and roundhouse.

The new power station is an all-turbine one, the only reciprocating machinery, save the boiler feed pumps, being two two-stage air compressors built by the Ingersoll-Rand Co., New York, and the Chicago Pneumatic Tool Company, Chicago, which furnish compressed air at 100 lbs. pressure, for the pneumatic drills, hammers and hoists about the shops. Three Curtis steam turbines and one motor generator exciter have been installed. The turbine equipment consists of the following units: One two-bearing, overhung, non-condensing turbine, speed 3,600 r.p.m., connected to a 25-kw., 125-volt, d.c. exciter; one four-bearing, three-unit, 100-kw., set, consisting of one four-stage non-condensing turbine, speed 3,600 r.p.m.; one three-phase, 60-cycle, 480-volt, 100-kw. generator, and one 4-kw., 125-volt, d.c. exciter; one three-bearing four-stage condensing turbine, speed 1,800 r.p.m., connected to a 750-kw., three-phase, 60-cycle generator. All of these turbines are equipped with oil pumps geared direct to the main shaft of the turbine, and the bearings are fitted with oil rings. The 750-kw. and 100-kw. turbines are equipped with cross-head mechanical valve gear driven direct from the main turbine shaft. The 750-kw. turbine is connected to a Westinghouse-Le Blanc jet condenser, the circulating and rotary air pumps of which are driven by a 75-h.p. induction motor. The injection water is cooled by a natural draft cooling tower. This arrangement is very satisfactory as it maintains a vacuum of 27 to 28 in.

The boiler equipment consists of five 275-h.p. Sterling, hand-fired, water tube boilers, equipped with shaking grates. The chimney is of reinforced concrete, 200 ft. high, and is provided with a Bushnell damper regulator. Bituminous coal is used.

The condensing and boiler feed water is supplied from a pumping station located outside of the shops. The feed water is pumped from an open feed water heater to the boilers by two duplex pumps, manufactured by the Platt Iron Works Co. The piping is so arranged that the feed water may be pumped direct from the hot well of the cooling tower. The engine room is spanned by a 7½-ton Harris hand crane.

About 1,000 h.p. of General Electric Co., Schenectady, N. Y., induction motors are distributed throughout the planing mill, tin shops, pipe shops, machine shop, boiler shop and roundhouse, ranging from 15 to 100 h.p. each, and are used to drive the different tools. Most of the motors are belt driven. The large planers, turning lathes, drill presses and boring mills are equipped with individual motor drive.

The dismantling shop is spanned by a 120-ton, four hook, electric crane, manufactured by the Harris Crane Co., and equipped with four variable speed induction motors of the slip ring type.

The buildings are heated by the exhaust steam from the two air compressors, boiler feed pumps, 25-kw. and 100-kw. turbines, and the condensation from the system is pumped into the boiler feed water heater. This arrangement puts a back pressure on the exhaust header of from 4 to 8 lbs.

The changes made in this plant are said to have brought about a saving in coal alone of 50 per cent. They are also said to have effected a saving of 66⅔ per cent. in the labor required to operate the plant. This is due partly to the improved methods of handling coal and ash and partly to the small number of men required to operate a turbine station. Besides the saving in the cost of coal and labor, the capacity of the shops has been increased. During the month of April this shop turned out 34 locomotives, which was the largest number ever repaired in one month.

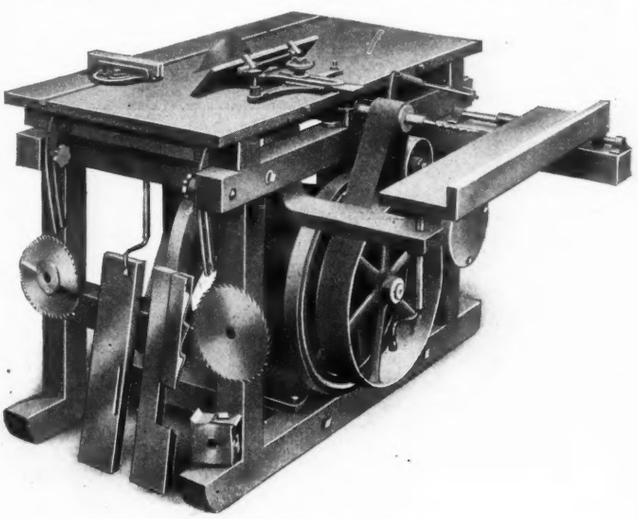
American Contractors Portable Saw Bench.

This machine is particularly adapted to the use of general contractors, concrete workers, contractors and builders and engineers. It is compact, self-contained and very substantially built. It is made portable, being intended to be taken to the job where it will most satisfactorily handle a large variety of light and medium mill work.

It consists of a combined rip and cut-off saw bench with boring attachment, jointer and dado heads, with a gasolene engine mounted on the frame directly under the table and belted direct to the mandrel. A V belt tightener is provided with adjustable spring take-up to insure the proper tension on the belt.

The frame and top are made of seasoned hard wood accurately framed and securely bolted together, insuring rigidity and durability. The top is hinged to the rear of the frame, and is readily raised and lowered by the hand screw and held in any position by the clamps on each side. The mandrel is 1⅛-in. steel, with self-oiling babbitted boxes, yoked together. The end has a ½-in. hole to receive the bit shank, and a hollow safety set screw to hold it securely.

The boring table has a steel slide, a travel of 6 in. in line with the spindle and a verticle adjustment of 3½ in. Adjustable ripping and cut-off gages are furnished. The ripping gage is provided with a tiling fence for bevel sawing and has rapid, fine adjustment and may be secured at any point. The cut-off gage slides in an accurately-planed iron grove, the entire length of the table, and can be set to cut square or any angle to 45 degs.



American Portable Saw Bench.

The regular equipment consists of Hooper cooled type engine

with batteries, spark coil and connections; driving belt; rip and cut-off gages; one 12-in. rip saw; one 12-in. cut-off saw; one ½-in. and one ⅞-in. dado head; one jointer head with four 2-in. knives; one ½-in. and one 1-in. auger bits; one cast iron jointer table with adjustable section for rabbitting; one throat piece for dado head; one throat piece for saws; oil can and wrenches.

This machine may be equipped with electric motor to suit any current or voltage. The floor space required is 54 in. x 54 in. The table of the machine is 54 in. x 30 in. x 1¼ in. Total height is 36 in The weight of the machine as described is 960 lbs., although wthout the boring attachment it weighs but 900 lbs.

This machine is made by the American Saw Mill Machinery Co., Hackettstown, N. J.

Exhibition of Bolt, Nut and Forging Machinery.

The National Machinery Company, Tiffin, Ohio, will hold an exhibition of bolt, nut and forging machinery at its shops in Tiffin, August 19, 22 and 23.

In 1908 this company remodeled and greatly enlarged its plant, installing a number of electric traveling cranes and adopting electric power throughout its shops. The designs of the former National machines have been greatly improved and will be exhibited along with a number of new designs, especially adapted to railway shop service.

The intention of the company in holding this exhibition is to familiarize railway officers and foremen with these new designs by demonstrating the machines under actual working conditions. Over 50 machines will be shown on the exhibition floor, most of which will be in operation. The exhibition will include forging machines, bolt headers, continuous and automatic rivet machines, several types of semi-automatic machines for tapping and burring hot pressed nuts, vertical roll threaders for handling bolts and long rods, lag and coach screw machines, which handle the screws direct from the header without previous cone pointing; bolt pointers, die sharpeners, bolt cutters, etc. Many of these machines will be motor-driven to illustrate the method of motor applications employed by this company.

An invitation is extended to all railways officers and foremen interested in these machines. The International Railway Master Blacksmiths' Association, which will be in convention at Detroit, August 16-18, will go to Tiffin by special train to attend the exhibition on Friday, August 19. August 22 and 23 will be devoted to the interests of the various other railway officers and the trade in general.

Improved Steel Axles.

The Gould Coupler Company has made several changes in its axle forge at Depew, N. Y., to insure the manufacture of the highest possible grade of steel axles for locomotives and cars. The former practice was to buy the steel billets, which had been rolled at the mills, and reduce and hammer them to shape under helve hammers. Axles made in this way were found to have a good hard surface but the material was not thoroughly worked at the center. An extensive investigation was made as to how this might be overcome, the final conclusion being that the billets, instead of being rolled, should be pressed, insuring the thorough and uniform working of the material throughout the axle, after which they could be finished under the helve hammer, as usual. This decided, the next problem was to find a satisfactory press for doing the work. It must be of high capacity and at the same time quick acting. Such a press, known as a high-speed steam-hydraulic forging press, Davy Brothers, Limited, patents, was being used extensively abroad and was about to be introduced in this country by the United Engineering & Foundry Company, Pittsburgh, Pa.; one of 1,200 tons capacity was contracted for and installed at Depew. Following is a comparison of the physical properties of the rolled and the new process axles, based on a carbon content of .35 per cent.:

Interior of Main Shop; National Machinery Co., Tiffin, Ohio.

	New process.	Rolled.
Tensile strength, lbs. per sq. in.....	85,000	68,000
Reduction of area, per cent.....	25 to 45	14 to 28
Elongation, per cent.	18 to 25	13 to 20

The specific gravity of the pressed axles has been found to be slightly greater than that of the rolled ones, undoubtedly due to the more thorough working. The billets are made at the Gould steel plant at Depew, so that the company controls the material in the axle from start to finish.

The 1,200-ton press is one of a large number of sizes which are being built by the United Engineering & Foundry Company, ranging from 100 to 12,000 tons in capacity and adapted for all classes of forging, shearing and pressing. They are superior to the steam hammer, both as concerns production and the soundness and accuracy of the forgings produced. The blow of the steam hammer is limited to a moderate and chiefly surface action on the steel, reducing the total thickness about ½ in., while the press can make a reduction in thickness of nearly 3 in. in practically the same time, making a stroke four to six times as effective as the blow of a hammer in approximately the same time, and working the metal through its entire

section, tending to solidify and eradicate any blow holes or defects; the hammer working more on the surface of the metal causes it to overlap and attenuates these defects. Another important advantage is that the high-speed hydraulic forging press can be operated with about one-half the steam consumption that a hammer of equal capacity takes. There is also a considerable saving in repairs and upkeep due to the absence of heavy shocks and vibration. By means of a patented single lever controlling gear, the hydraulic forging press can be operated at a high rate of speed—fully as fast as a steam hammer. By this single-lever control the movement of the presshead exactly follows that of the controlling lever, as regards both speed and length of stroke, so that while the high speed can be obtained for certain classes of work, a slow speed may also be used when forging to exact size or for such operations as punching and shearing.

The press consists of the press proper with the main hydraulic cylinder and steam lifting cylinders, and the steam-hydraulic intensifier equipped with the patented single-lever controlling gear, also the air tank or prefiller, with air and water pump to fill the prefiller to a pressure of about 60 lbs. per sq. in. and refill periodically to take care of any leakage that may occur. Its operation is as follows: The total stroke of the intensifier gives to the presshead an active stroke of 6 in. This stroke is ordinarily sufficient for forging and swaging, as well as for finishing, but where a longer stroke is required, it can be obtained by an additional stroke of the operating lever. For lifting the crosshead to its highest position, the operator moves the controlling lever a little backward, and the

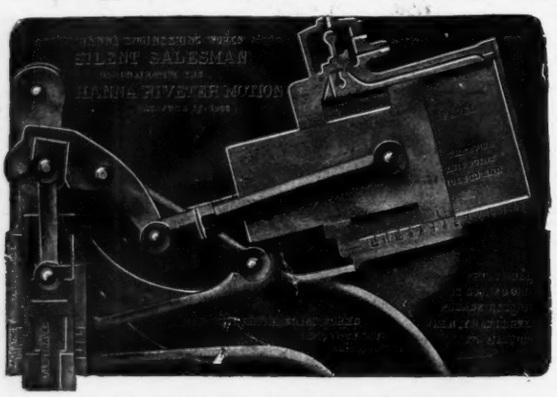
1,200-Ton Press in Gould Axle Forge, Depew, N. Y.

crosshead will rise to such a height as may be required, the water in the main cylinder returning into the prefiller. As soon as the operating lever has again moved forward, the water of the prefiller, through the action of the compressed air, will flow back into the main cylinder, making the presshead drop instantly, and the working stroke commences as soon as the die touches the forging. There are two kinds of operations, that of working with short strokes for quick forging, and that of having the press make long strokes, which can be increased up to the maximum stroke of the main cylinder, but both kinds of movements may follow each other instantaneously, following simply the movements of the operating lever. This lever can be moved by the operator without any noticeable effort and its movements are always faithfully followed by corresponding movements of the presshead of the press.

The intensifier and prefiller are separated from the press as shown in the illustration. The hydraulic cylinder of the intensifier is fitted with a patent stuffing box, which allows the packing to be changed in a few minutes, and without disturbing any important part.

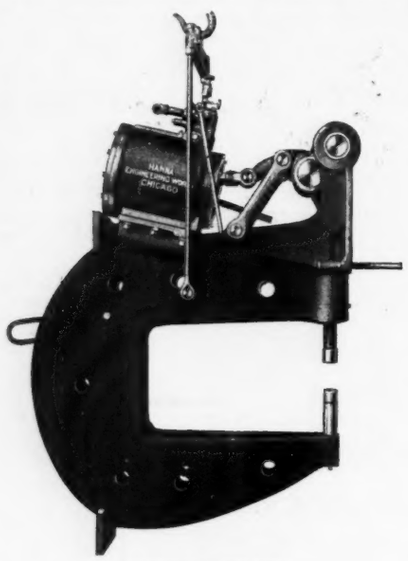
Hanna Pneumatic Riveters.

In the Hanna type of riveter there is a combination, in simple form, of toggles, levers and guide links to give the large opening of the toggle joint movement with a gradually increasing



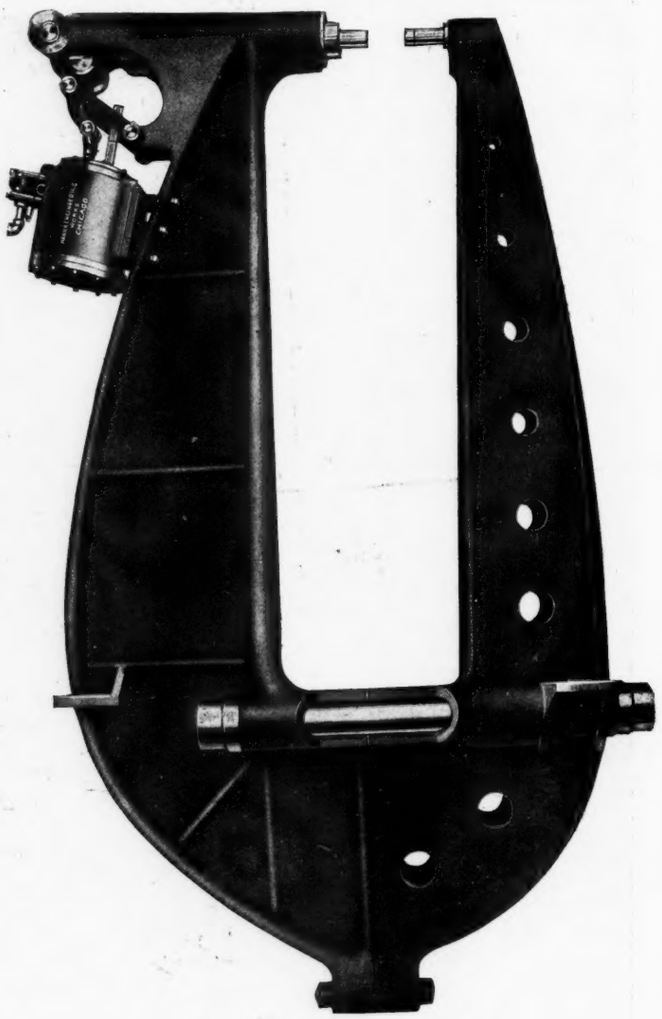
Cross Section through Cylinder.

pressure and then a simple lever movement throughout a considerable space under maximum pressure. This space is sufficiently great to assure the proper pressure being applied to



Hanna Riveter.
Reach, 36 in. Gap, 21 in. Pressure, 70 tons.

the rivet, and the machine once adjusted for a certain length of rivet and thickness of plate will require no further adjustment for ordinary variation in those dimensions, thus producing hydraulic results with a pneumatic riveter. The arrangement of these levers and toggles, and also of the cylinder and valve, is shown in the cross section through the cylinder. The characteristic features of the Hanna type of riveter are as follows: Only one blow is required to a rivet, on account of the considerable distance through which the pressure is exerted; careful adjustment is unnecessary, and it is only required to strike the rivet once. With the adjustment necessary for an ordinary riveter, the Hanna type will accomplish the same result with one-half stroke. For this reason it requires much less air than other types, which often require from two to four strokes to properly drive a rivet. The Hanna type, therefore, saves time and air. The uniformity of the work done by this riveter has often been shown by the most exacting inspection and testing. The construction of the machine and the methods of lubrica-



Hanna Pneumatic Riveter.
Reach, 75 in. Gap, 21 in. Pressure, 70 tons.

tion are such as to make the wear and tear of this riveter very slight.

The same firm manufactures a hydro-pneumatic type of riveter, in which the riveting die is connected directly to the hydraulic plunger, which is acted upon by both high and low pressure. The low pressure brings the die up to the rivet, and the high pressure is applied for the final upsetting. The low pressure also returns the die to its original position. The high pressure is produced by an intensifying arrangement composed of an air piston operating a much smaller hydraulic plunger, all self-contained within the riveter. This machine gives results about the same as the plain hydraulic machine without the trouble of conducting water under a very high pressure.

The Hanna Engineering Works, Chicago, manufacture a large line of pneumatic and hydro-pneumatic riveters, both plain and toggle joint.